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Railway Mechanical Engineer

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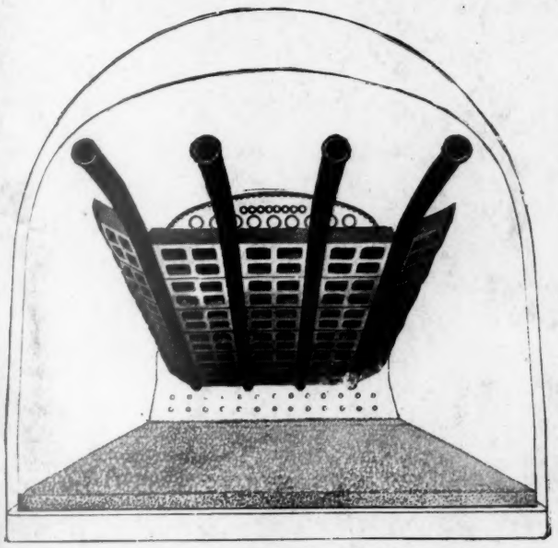

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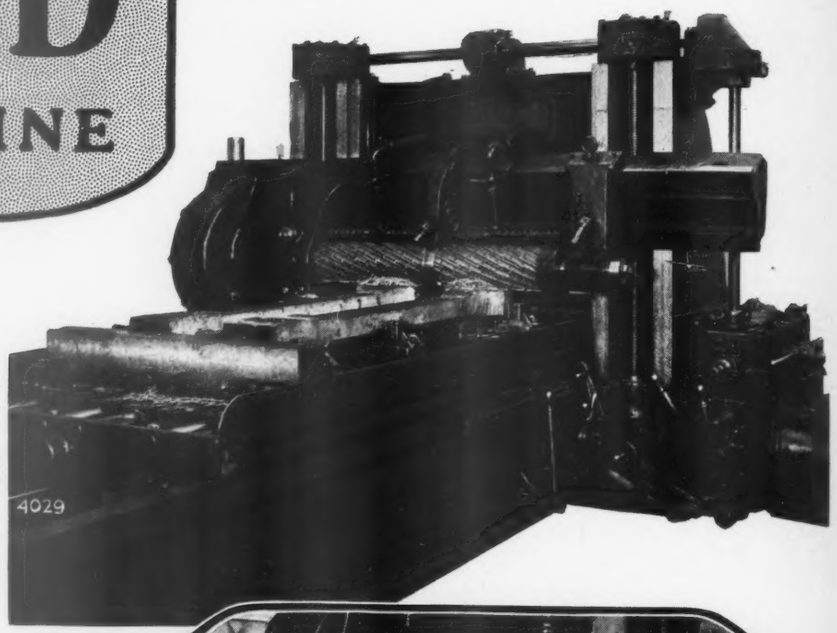

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Railway Mechanical Engineer

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Railway Mechanical Engineer

Vol. 100 October, 1926 No. 10

It was pointed out by two of the speakers at the recent convention of the Equipment Painting Section at Detroit that the possibilities for those in charge of equipment painting to effect economies in operation are greater than at any time in the past. The statement was made by a master car builder some time ago that the out-of-shop time of a passenger car is to a great extent dependent upon the life of its paint. The importance of protective coatings has materially increased since the advent of steel equipment due to the tendency toward rapid deterioration of unprotected steel surfaces.

Proper painting saves maintenance

The Equipment Painting Section, as evidenced by the reports presented at the recent convention, has recognized that changes are taking place in the development of protective materials and methods for their application and shows a marked spirit of progressiveness in anticipating the economies that may be expected from the use of improved materials and methods. Probably the most interesting discussion during the recent convention concerned the rapid development of the use of lacquer finishes. The fact that it is one of the most important of the recent developments in the painting field should assure the presentation of a great deal of interesting material on its use at next year's meeting in Louisville. The work of the Equipment Painting Section has been more or less in the background as compared with the work of some of the other branches of the mechanical department, but the importance of this phase of railway equipment maintenance is constantly growing. Upon the proper protection of surfaces will depend, to a great extent, the increase in service life of rolling stock and mechanical officers in charge of car work will find more and more to interest them in the association which is foremost in guiding the development of new and improved methods of equipment painting.

We have had frequent requests for information as to books which would be helpful to officers, supervisors and foremen in getting a better understanding of the human relations problem or assist them in improving their leadership ability. Many books are now being published on problems of industrial management and industrial leadership. The extent to which they can be helpful to the practical man in industry and transportation, of course, depends upon the man's particular experience and viewpoint. It must be remembered that improvements in industrial management have been going forward rapidly in recent years, as the human relations problem has become better understood and its vital relationship to industry has been more clearly recognized. Just as the physician or scientist must keep in touch with improvements and progress in his particular field, so the industrial executive and foreman must deliberately plan to study progress in the field of management and leadership. This publication has consistently tried to keep its readers informed on these questions. It is trying to make itself still more useful by calling attention, in a series of articles to be published regularly, to what it conceives to be the latest and best books on these subjects which will be helpful to railroad officers and foremen. The second article of the series appears elsewhere in this number. Is this sort of thing helpful to you? Have you any concrete suggestions as to the particular type of books that you would like to see reviewed in these columns? It will encourage and assist the editors if you will let them know of books which have been particularly helpful to you in your work. One mechanical superintendent has called our attention to a particular book with this notation: "You will enjoy this—the man problem is much discussed." We shall have something to say about this book in our November number.

Books to read

Those attending the recent convention of the International Railway General Foremen's Association in Chicago could not help but be impressed by the increasing influence exerted by organizations such as this. Last year's officers of this association are to be commended on the excellent program which was presented and its reception should encourage the new officers to broaden the scope of the association's work. The General Foremen's Association needs the assistance which a larger membership will give it and its officers have demonstrated the organization's ability to be of such valuable assistance in the promotion of mechanical department interests as to warrant the support of every eligible supervisor.

General Foremen can exert great influence

Big problems are before the mechanical departments which must be solved. In the subjects at the recent convention it may be seen that this association has recognized the growing importance of such factors as shop production, machine tools and foreman and apprentice training. One speaker told of the vital necessity of stabilizing employment and of making improvements in wage payment and cost data systems. The responsibility for the solution of such problems must rest with those men who are close to prevailing conditions in the shop—and who comes in any closer contact with all phases of shop operation than the general foreman?

The balancing of shop sub-departments—one of the topics—is of far greater importance than at first it may seem. A properly balanced shop is one having an organization which will produce maximum output within a minimum time. Proper organization results in a healthy reduction of force to a point where maximum and minimum demands may be met with no great fluctuations in

the number of men required. The solution of one problem therefore may be a contributing factor in the solution of the more difficult and important problems.

Machine tools as a factor in increased production—here is a subject worthy of more careful study than has yet been given it. The railroads spend vast amounts for new machine tool equipment and it is doubtful if in all cases this money is spent in a manner that assures the greatest return on the investment.

When it comes to the development of mechanics and foremen, who is more directly concerned than the general foreman? In the training and handling of men we have just barely scratched the surface. Changing economic conditions have demanded new methods in industrial relationships and one must keep pace with the changing tide of developments in order to cope successfully with new problems.

The General Foremen's Association has gone far in recognizing the importance of these things, but the big job is ahead. The future of the Association and the scope of its influence will depend largely on the next move. If the members of the organization will but catch a vision of its possibilities and the far reaching influence it can exert they will work untiringly to increase the membership and assist in the preparation of a program for the 1927 convention that will be of such significance that no wide-awake mechanical department officer would risk not being represented at its sessions.

What's in a name?

When for twenty-five years a group of men with a common purpose has been working together in an association, the name of that association acquires a significance far beyond a mere description of the group. To the older members it stands for fellowship of the highest order; it recalls memories of struggles and of defeats which were never quite defeats because, through courage and persistence, they were ultimately turned into success; it signifies progress from weakness through opposition to strength and influence. To the younger members it signifies permanence—an established institution in the work of which they are proud to participate. Indeed, the name becomes the emblem of all that has gone into the building of the character of the organization and, as such, is not lightly to be changed.

In the course of its growth, however, the very success with which it has achieved the purposes for which it was organized may open up widening opportunities for service to its industry which may require a broadening of the scope of its work that can most quickly be made known to its field by a more clearly descriptive name. It is then that the overruling of sentiment and tradition is evidence of a sound and forward-looking organization. Such was the case with the Chief Interchange Car Inspectors' and Car Foremen's Association of America when in convention at Chicago, September 21, 22 and 23, it voted to change its name to the Railway Car Department Officers' Association.

This association of interchange inspectors and car foremen was founded in 1901, and the membership has now grown to exceed 1,300 in number. It was particularly fitting that at this convention, which is its silver anniversary, the association should tighten its belt and prepare for still more aggressive work in the interest of the railroads as a whole. The selection of the new name is not designed to change in any way the amount or character of the work done by the former Chief Interchange Car Inspectors' and Car Foremen's Association, but simply to broaden its scope and encourage membership by car department supervisory officers of all ranks.

Comment on this year's convention would be incomplete without special emphasis on the attempt made to secure some practical solution of the present difficult problem of excessive transfers of loaded cars. In the case of loaded cars with transferrable defects not of such a nature as to prevent safe operation of the cars in trains, there was a decided difference of opinion regarding the advisability of the delivering line guaranteeing rebuttal transfer should subsequent transfer of the load prove unavoidable, but the association was practically unanimously in favor of a set of resolutions presented as the solution of the transfer problem by C. J. Nelson, chief interchange inspector, Chicago. These resolutions are printed in full on another page of this issue and it seems apparent that if all railway forces responsible for the maintenance and handling of car equipment can absorb and live up to the spirit of these resolutions, the transfer problem and also a considerable part of the loss and damage problem will be solved to the great financial advantage of railways, shippers and the general public.

A new era of railroading

Not many years ago, one of the tendencies in the railway industry which was disturbing to many observers interested in its welfare was the growth of departmentalism. There seemed to be a strong tendency for the heads of the various departments, particularly the technical departments, to regard with professional jealousy the work of their own departments, with apparently little disposition to acquire a broad vision of the operations of the railroad as a whole. Mechanical department executives seemed prone to carry with them into their executive positions the viewpoint of the shop supervisor and to measure the broad problems of the department by their relations to the shop and roundhouse rather than by their relations to the operation of the railroad as a whole. Operating officers who attained executive positions too frequently were unable to visualize the needs of other departments in their broader relations as operating factors.

This growth of sharply defined departmental compartments in the structure of the railway organization seemed to be the logical outcome of the growth in size of railway properties to a point where some observers were asking themselves whether it was within human capacity for the individual to attain a knowledge and understanding of railway operations as a whole sufficiently comprehensive to break down these departmental walls, without sacrificing his ability to deal with the increasingly complex problems within his own department. A survey of the situation today, however, reveals many evidences that these walls are being lowered, if not completely removed, with surprising rapidity. No attempt will be made at this time to set down all of the factors which may have brought about this change. Were they all to be traced back to their source, however, it is probable that they would be found to spring from the almost limitless capacity of the human intellect when controlled by ambition—not ambition for self-improvement alone, but ambition for the improvement of a great industry.

A striking evidence of this increase in breadth of vision is afforded by the recent convention of the Traveling Engineers' Association. This organization has long been an important factor in the education of traveling engineers in their specific duties of training men in the management and manipulation of the steam locomotive in service. In the recent convention, however,

a full day was given over to a symposium on the steam locomotive, covering motive power design, utilization, maintenance and improvement—subjects embracing the problems of executive, operating and mechanical officers, and most of their supervisors.

This is, perhaps, an outstanding example of association work for which the Traveling Engineers' Association deserves full credit. It is, however, only an example of the character of work which is being done by several associations of supervisors and officers coming wholly or partially within the field of the mechanical department. A study of the proceedings of the recent convention of the International Railway General Foremen's Association, held last month, and of the International Railway Fuel Association convention, held in May of this year, will bear out this statement. All of these conventions bring out strongly the disposition on the part of departmental officers and supervisors to regard their broader problems as not for solution by themselves alone, but as problems of railroading which must be solved co-operatively for the best interests of the organization as a whole.

These officers and supervisors are building sound foundations for the future structures of their respective associations and for the future structure of the transportation industry when they take advantage of the tremendous educational possibilities of their associations to hasten the acquirement of a broad knowledge of their industry as a whole and a sound comprehension of its problems.

Tool standardization proposed

The outstanding feature of the American Railway Tool Foremen's convention, held at Chicago, September 1, 2 and 3, as reported on another page of this issue, was the work on standardization (or perhaps better called "simplification") of small tools used by railroads. While as yet the association has little more than scratched the surface of possibilities along this line, it is apparently proceeding in the right direction. After exhaustive discussion and argument at the 1925 convention, the association agreed on the best general design and construction of a limited number of sizes of locomotive taper frame and rod reamers, the adoption of which will be of substantial benefit to the railways as a whole in a number of ways. This year the association agreed on a much more difficult subject, namely, the general designs of boiler taps, the form of threads, and the number of threads per inch in a limited number of sizes. A standing committee on standardization will report on other tools at subsequent conventions.

The advantages of this work are many. The trouble at the present time is that each railroad has so many different styles of each type of small tool, these styles differing slightly on different railroads, that the manufacturers are greatly handicapped in any attempt to install production methods on any one style and carry it in stock. The railroads accordingly in many cases have to pay relatively high prices for small tools and cannot get prompt deliveries. Another advantage of fewer tool types and sizes on the railroads as a whole will be that manufacturers can then get sufficient production to justify them in making many of the special tools now made by the railroads for themselves at excessive cost and sometimes with inferior quality. By getting together and giving joint consideration to the needs it is unquestionably true that the railroads can substantially reduce the number of types and sizes of small tools to their mutual advantage as well as to that of the manufacturers.

The work of the American Railway Tool Foremen's Association in standardizing small tools was commended by E. W. Ely, assistant director of the National Metals Utilization committee, Department of Commerce, Washington, who in an address on "Simplification" pointed out the tremendous waste in industry as a whole on account of the multitudinous variety of objects manufactured, and explained what has already been done to improve the situation. Within the past few years paving brick has been reduced from 66 varieties to four with an estimated annual saving of $1,000,000. Sheet steel of 1,819 varieties has been reduced to 261 varieties with an estimated annual saving of $2,400,000. A reduction of 60 per cent in lumber varieties has resulted in an estimated saving of $250,000,000 annually. Mr. Ely pointed out that *Simplified Practice* is not *Standardization*, but simply a reduction of the variety of sizes, dimensions and immaterial differences in every day commodities as a means of eliminating waste, decreasing costs and increasing profits, to the ultimate advantage of the manufacturer, dealer and user. To continue the comparison above, files, rasps, milling cutters, chasers for self-opening die heads, grinding wheels and similar material have been simplified, the average reduction in variety being 59 per cent. In grinding wheels alone, for example, 715,000 varieties have been reduced to 255,800 with an obvious saving to all concerned in the manufacture, distribution and use of this important type of equipment.

The railroads are important users of material of all kinds including tools, and stand in a position to be of great help in the program of waste elimination being fostered by the Department of Commerce. Obviously, if railway ideas regarding tools and equipment can be unified and passed on to the equipment manufacturers the latter will be able to co-operate with the railroads to their mutual advantage. For the maximum benefit it is essential that each railroad adopt a simplification program for small tools coinciding as nearly as practicable with that of other roads. It would appear therefore that this subject is one on which the American Railway Association, Mechanical Division, should take action, doubtless leaning heavily on the advice and recommendations of such associations as that of the tool foremen and shop foremen who in the last analysis are the users of tools and best understand the requirements.

New Books

THE AIR BRAKE ASSOCIATION PROCEEDINGS, 1926. *Edited by the secretary, F. M. Nellis, 165 Broadway, New York. 350 pages, illustrated, bound in leather. Price $3.00.*

This book contains the proceedings of the thirty-third annual convention of the Air Brake Association which was held at New Orleans, La., May 4, 5, 6 and 7, 1926. The reports and papers submitted were on the subjects of air brake hose coupling gages, retaining valve testing, air brake tests of locomotives and trains in accordance with government laws, triple valve repairs, modern freight train handling, manufacture of wrought iron pipe, recent improvements in passenger train braking, better insulating of steam cylinders for air compressors, brake pipe leakage, threading and bending of air brake pipes for locomotives and cars, manufacture of steel pipe, and recommended practice. The table of contents lists all the reports and papers printed in the proceedings since 1894. This affords an excellent reference for those who have occasion to refer to work of the association during past years.

Survey of employee representation*

The second of a series of discussions of books on improved supervision and better employee relations

NO one man has done more to help develop the fundamental principles of successful management and focus attention upon human relations in industry than Dr, Henry C. Metcalf. In presenting him two years ago as one of the judges in the Railway Age competition for the best articles on co-operation in the interests of greater economy and efficiency on the railroads, this statement was made: He "is characterized by one who knows him well as being 'eminently successful in humanizing economics'; by another, 'as an interesting combination of idealist and practical go-getter when it comes to applying sound principles. He is keen, intense and tremendously stimulating to those with whom he comes in contact and absolutely intellectually honest.'"

Doctor Metcalf early recognized the advisability of having a thorough study made of employee representation. He succeeded in enlisting a number of individuals and concerns in financing the costs of the investigation. The next step was to find a man who could make such a survey under the direction of Doctor Metcalf. Ernest Richmond Burton, who had already made some study of employee representation, was finally induced to make the survey. In the words of Mr. Burton, in the preface to the book which has recently been published: "At every point in the recent investigation Doctor Metcalf has counselled most helpfully and patiently; and through his wide contacts in industry he has facilitated access to important data." Incidentally, Mr. Burton's treatise has a foreword by Dr. Metcalf and the book itself is one of the "human relations series of books" which have been brought out under the editorship of Doctor Metcalf.

While there are several hundred examples of employee representation in industries in this country, it was thought best to pick out a limited number of installations and make a careful first-hand investigation of these, rather than to make a more extensive but less thorough study. This was supplemented by several roundtable conferences, held in various parts of the country, by business executives who have had more or less experience with employee representation.

The report prepared by Mr. Burton proceeds first to build up the right sort of a background for the study and then in the 13 following chapters discusses the needs and purposes of employee representation, the methods of organization and procedure, the administration and finally the results under three headings: (1) terms and conditions of employment, (2) output—efficiency—morale, (3) evaluation. Appendices furnish statistical data relating to certain employee representation plans and also present a selected bibliography.

The discussion of the book in greater detail presents a difficult task because of the thorough way in which the entire subject is treated and the vast amount of information which is included. Doctor Metcalf's foreword is a gem in itself, as is indicated by the two following quotations from it:

"Employee representation is making at least three significant contributions to American industrial life. It is converting industry from a purely productive process, turning out massed material units, into an educational experience for all engaged in its absorbing activities. It is facilitating the realization of a more truly scientific method of management. Through its operation as a means of orderly, industrial governance, it is injecting new meaning and value into that much maligned concept, democracy."

"Employee representation is developing the habit among executives and among the rank and file of weighing human attitudes, of including human desires among the factors entering into the solution of management problems, and of placing them in their proper relation to other elements—material and economic—which must be taken into consideration."

It must. of course, be kept clearly in mind that employee representation is a comparatively recent development in American industry. Few attempts have been made thoroughly to analyze its purposes or to outline its fundamental principles. There has therefore been going on in recent years a great deal of experimentation, depending to a large extent on the personalities of individuals who have been fostering employee representation, and local conditions. It is not surprising to find in Mr. Burton's report, therefore, a wide diversity of ideas and methods concerning employee representation. The outstanding purposes of employee representation from the employer's standpoint, however, as gathered from roundtable discussion on the part of the executives, are as follows:

"(A) Double track channel of communication for exchange of information, opinions and desires.

"(B) Procedure for prompt adjustment of individual and group misunderstandings, complaints and grievances.

"(C) Procedure for collective negotiations (unhampered by external influences or irrelevant issues making for fruitless controversy), regarding wages, hours, and other terms of the employment contract.

"(D) Education of employes. (1) Of the rank and file, to appreciate in some degree the difficulties of the managerial functions not only regarding wages, hours and other matters usually regarded as directly affecting employees, but also with reference to larger policies of finance, production, marketing and public relations. (2) Of persons in supervisory positions who, through serving as management representatives on joint conference committees, may acquire a broader comprehension of managerial responsibilities, particularly those affecting personnel relations."

Naturally in inaugurating a plan of this sort steps must first be taken to educate the supervisors and foremen as to its objectives and to see that they are thoroughly informed and in sympathy with the plan. The detail procedure for launching several plans of this sort is given, as well as suggestions as to the various provisions for amendment and termination of the agreements and the best time at which to introduce employee representation. It is important that the management assume responsibility for the effective operation of the plan and steps must also be taken to assure adequate representation of the employees. These points are clearly developed.

Then follow discussions of joint conference bodies and various details associated with such conferences. After the presentation of the underlying principles governing the essential features of employee representation, follow

*Employee Representation, by Ernest Richmond Burton, supervisor of research, Bureau of Personnel Administration. Published by the Williams & Wilkins Company, Baltimore, Md. Bound in cloth, 283 pages, 8 in. by 5¼ in. Price, $3.00.

several chapters including discussions of some of the more important problems of its operation, and of the need of a periodic audit of progress.

Naturally, special interest will be directed to those parts of the survey which deal with the results of employee representation; three chapters are required for this purpose. The first one on "Results—Terms and Conditions of Employment" includes a discussion of examples of matters negotiated under employee representation, collective negotiations under employee representation, trade union criticisms of employee representation, intimidation of representatives, lack of expert counsel and power under employee representation, demonstrated ability of employee representatives, and do employees need union affiliation. Under the latter head appears this significant statement: "Thus, while the works council or its employee members, if it is a joint body, possess no weapon such as the unions' 'war chest,' a treasury available for financing strikes, need for such defensive armament is less likely to arise, since employee representation promotes a partnership spirit which treats conflict as a constructive force."

In summing up the chapter on the results from the standpoint of output, efficiency and morale, the author makes this statement:

"We cannot emphasize too strongly, however, that these products of employee representation—greater output, increased efficiency and improved morale—cannot be achieved (1) unless management policies and practices respecting wages and working conditions are as satisfactory as those of competitors in the labor market and have been justified in the minds of employees as the result of frank discussions or negotiations with their representatives; (2) unless the administration and managerial staff is itself efficient and obviously so; and (3) unless the management is ready to discuss frankly with employee representatives actual, tangible problems confronting it, and upon which it genuinely desires employees' advice and co-operation. If these three conditions are established, co-operation of employee representatives will be forthcoming. If the representatives continue faithful to their constituents with respect to the matters of vital interest to them, their prestige will enable them to win for the management the confidence and co-operation of the entire force."

Employers have adopted employee representation for various reasons; in the railroad field, so far as the mechanical department is concerned, primarily because the former conditions were unbearable and it was necessary to find some way of building up the right spirit of co-operation and teamwork and insuring efficient and economical operation of the railroads with continuity of service. As in other industries, it was necessary in taking up this plan to do more or less pioneer work. Some roads have made much progress in building up a strong and substantial organization on this basis. Others may not have been quite so successful, but at the same time have made substantial progress. The point that Mr. Burton makes in his closing chapter on "Results: Evaluation" is that, "Employee representation requires a higher type of management than is necessary without it. Executives and their staffs need not only to be technically 'on their toes,' but to understand more fully and sympathetically the human values involved in industrial operations. But the greater effort and the keener intelligence which employee representation demands is amply rewarded in the morale which it engenders."

The book closes with the significant statement that "the growth of the movement may be slower than in the past, but it is likely to be more permanent than that of the earlier years, since the basic principles which should underlie employee representation have been fairly well indicated by experience of the last decade."

The railways and industries are under deep obligation to Doctor Metcalf and Mr. Burton for this extensive and thorough, scientific study of employee representation. The book is not one which can be picked up lightly and laid aside thoughtlessly. It must be read and studied carefully and critically. It represents in many ways one of the most important contributions that has thus far been made to the analysis and scientific study of industrial management.

Lubrication of steam locomotives

A discussion of the relative merits of oil and grease for lubricating locomotive journals

By Geo. W. Armstrong

GREASE is the commonly accepted means of lubricating locomotive driving journals, although oil is still used for engine truck and trailer axles. Grease does not lubricate except after the journal becomes warm enough to soften it, and clearance is needed between the journal and bearing to permit sufficient movement of the journal to allow the grease to feed. It has a higher frictional resistance than oil. However, lubrication without appreciable heating demands continual application of the lubricating medium. Grease, due to its body or cohesion, is susceptible of being kept in contact with the surface to be lubricated by a spring actuated follower. Oil lubrication in the past has depended upon wool waste with its capillary attraction to conduct the oil up to the surface to be lubricated. The constant shocks received in running tends to pack the wool waste and thus impair its lubricating functions. In fact there are times when the waste will compact to the point where no lubricant is delivered to the bearing at all. The glazing over the surface strands of the packing due to continual contact with the rotating journal will also destroy the capillary attraction of the waste.

Grease has less adhesiveness than oil, and it will not adhere to the surface of the journal sufficiently to become wedged between the journal and the bearing, without sufficient clearance or looseness to permit the grease to be carried up into the bearing by clinging to the journal before the bearing comes in contact with the journal. This is made possible by the backward and forward movement of the journal. This theory is borne out by the fact that it is impossible to lubricate with grease journals other than driving journals subject to reciprocating power transmission. Engine truck journals, trailer journals and electric locomotive driving journals, except jack shaft rod drive locomotives, cannot be grease lubricated.

A system of oil lubrication which will insure a continuous flow of oil would overcome the defects of the wool waste system and combine the advantages of the continuous grease lubricating system with a reduction

in frictional loss, which will be discussed later. Two systems, or rather methods, of oil lubrication other than the common wool waste method are available; namely, force feed and splash feed. Experiments have shown that the capacity of a high speed bearing to carry its load depends upon the fact that the journal never runs concentric with its brass. If lubricant is fed between the two surfaces, the area through which it enters the clearance space between the journal and its brass, being larger than the area through which it escapes on the opposite side of the bearing, a pressure is set up in the film of oil which effectually spearates the metal surfaces. Further experiments by Beauchamp Tower* showed the pressure of the oil at the top of the bearing varied from 310 to 625 lb. per sq. in., the greatest pressure being a little to the "off" side of the center line of the top bearing, in the direction of motion of the journal. This would tend to explain the failure of force feed lubrication to lubricate successfully from the top or side of the bearing.

The splash system of lubrication floods the bottom of the journal with oil. It is now successfully utilized in engine truck lubrication with marked improvement over waste fed lubrication.

Tests were made at Purdue University in 1906 with a 4-4-2 type locomotive having 95,000 lb. weight on the drivers, a total weight of 176,000 lb. 21-in. by 26-in. cylinders, 200 lb. boiler pressure and a tractive force of 24,600 lb., with oil and grease lubrication. These tests were reported by Professor Goss to the Master Mechanics' Association in 1906 as follows:

"The results show that with slow speed the friction of the machinery with grease lubrication is greater when hot than when cold, while at higher speeds results are contradictory, but the differences are in no cases great. The results also show that with oil, the friction under all conditions of running is higher when the machinery is hot than when cold, though in this case the differences are very slight.

"Accepting the oil lubrication as a basis of comparison, it appears that at 20 m.p.h. the loss of power resulting from the use of grease is slight, so small in fact as to be almost negligible, but as the speed is increased and at 60 m.p.h., it amounts to from 140 to 160 hp. The equivalent coal loss, assuming 4 lb. of coal per hp.-hr., is something more than 500 lb. per hour."

The Purdue tests, a summary of which is given in Tables I and II, constitute the only available record of tests to determine the relative efficiency of grease and oil lubrication. However, the St. Louis tests in 1904 covered two Consolidation locomotives of similar dimensions, one of which was oil lubricated, the other grease. An analysis of the test results of these locomotives tends to confirm the observations made at Purdue.

The test results shown in Table III substantiate the theoretical conclusion that friction developed with grease lubrication will be greater than oil for two reasons; first, when grease is cold, its cohesion is greater than oil and its adhesion to the bearing surfaces is less and consequently the coefficient of friction is higher, and second, when grease is in a fluid or semi-fluid state, its cohesion while less than in the solid condition, is still greater than oil. Its adhesion to the bearing surfaces, while greater than in the solid state, is, however, less than oil, and consequently the coefficient of friction is higher.

The expenditure of greater frictional energy is evidenced by the greater heating of a journal grease lubricated, which heat is required to reduce the solid grease to a fluid state.

Due to the increased friction of grease over oil lubrication, greater clearance in the driving box frame journal assembly must be allowed to take care of expansion, where an engine is grease lubricated. This is reflected in the amount that a wedge is pulled down after being set up tight, when the machinery is cold. A wedge that must be pulled back ⅛ in. with oil-lubricated journals would need to be pulled down ⅜ in. grease lubricated.

Table I—Summary of Purdue test results, showing the pounds pull at the drawbar necessary to overcome friction of the locomotive with oil and grease

Speed of locomotive	20 m.p.h.		50 m.p.h.		60 m.p.h.	
	Grease	Oil	Grease	Oil	Grease	Oil
Cold start	1,578	1,435	1,862	555	1,727	655
Hot start	2,222	1,549	1,628	780	1,804	873
Average	1,900	1,492	1,745	667	1,765	764
Tractive force lost by use of grease	408		1,078		1,001	
Horsepower	21.8		143.7		160.2	
Coal lost per hour run (assuming 4 lb. per hp. hr.)	87.2		574.8		640.8	

What does this mean in practical operation? Before answering, a brief review must be taken of the laws of friction of well lubricated journals.

1—Frictional resistance, all other conditions remaining constant, increases directly with the pressure between the masses in contact.

2—The Frictional resistance is directly proportional to the area of rubbing surface, the normal pressure remaining constant.

Table II—Relative machine efficiency for oil and grease

Test	No. tests	Drawbar pull Equiv. I.hp.	Drawbar pull Equiv. Aver. obs.	Friction loss	Machine efficiency
Oil					
Engine cold, 20 m.p.h.	7	9,088	7,651	1,435	84.3
Engine hot, 20 m.p.h.	21	9,157	7,609	1,549	83.2
Engine cold, 50 m.p.h.	5	5,326	4,772	554	89.8
Engine hot, 50 m.p.h.	18	5,593	4,813	780	86.3
Engine cold, 60 m.p.h.	11	5,114	4,459	655	87.3
Engine hot, 60 m.p.h.	20	5,061	4,188	873	82.7
Grease					
Engine cold, 20 m.p.h.	35	9,061	7,482	1,578	82.5
Engine hot, 20 m.p.h.	52	9,981	7,758	2,222	77.8
Engine cold, 50 m.p.h.	16	5,302	3,441	1,862	64.9
Engine hot, 50 m.p.h.	9	5,332	3,704	1,628	69.6
Engine cold, 60 m.p.h.	9	5,023	3,295	1,727	65.5
Engine hot, 60 m.p.h.	9	4,948	3,144	1,804	63.6

3—The coefficient of friction at very low journal speeds is abnormally high; but as the speed of sliding increases from about 10 to 100 ft. per min., the friction diminishes, and again rises when that speed is exceeded, varying approximately as the square root of the speed.

4—The coefficient of friction, other conditions remaining constant, varies approximately inversely as the temperature, within certain limits, i. e., just before abrasion takes place. (The Purdue tests, however, showed an increase in temperature.)

5—Frictional resistance is proportional to the density of the fluid, but related in some way to its viscosity.

The laws of friction given above state that resistance due to friction varies directly with the pressure between the masses in contact, and is directly proportional to the area of rubbing surface, or what amounts to the same thing, the projected area of the bearing—the journal diameter times the length. The journal size bears a fixed relation to the driving wheel load, consequently the frictional loss will vary directly with the load. Assuming that this is so, the same percentage loss will be developed with grease lubrication due to the increased friction, in a modern locomotive as in those tested in 1904 and 1906.

As a result of the observed difference in machine efficiency of various oil and grease lubricated locomotives in the St. Louis tests, the following statement was made: "It appears from an inspection of the plotted data that the use of grease may be expected to increase the friction losses per journal by from 75 to over 100 per cent." This observation would seem to be warranted by an examination of the chart prepared from the Purdue tests

* See January, 1885, proceedings of the Institute of Mechanical Engineers, London, England.

and those of locomotives 1499 and 734 in the St. Louis tests. It would appear that under good oil lubrication the loss varied from 10 to 15 per cent, while with grease lubrication the loss varied from 18 to 30 per cent.

In addition to the locomotives previously covered in this discussion there is plotted on the chart the machine efficiencies of locomotives No. 3,000 and No. 535, four-cylinder balanced 4-4-2 type locomotives of the New York Central and Atchison, Topeka & Santa Fe,

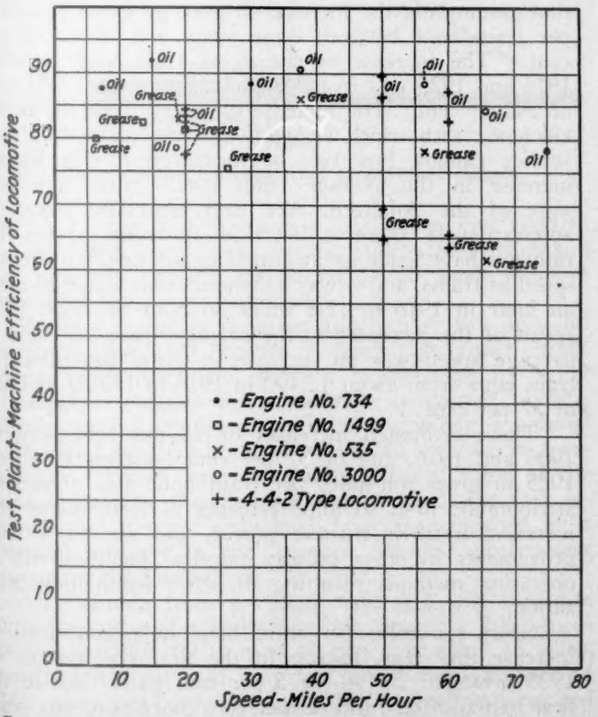
Table III—Summary of St. Louis tests, 1904

	Penn. Eng. No. 1499	L. S. & M. S. Eng. No. 734
Method of lubrication	Grease	Oil
Tractive force	42,168 lb.	35,800 lb
Weight of drivers	173,200 lb.	162,600 lb.
Diameter of drivers	56 in.	63 in
Cylinders, diameter and stroke	22 in. by 28 in.	21 in. by 30 in.

Engine No. 734 (Oil)

Speed m.p.h.	No. tests	Drawbar pull: Equiv. i.hp.	Drawbar pull: Aver. obs.	Friction loss	Machine efficiency
7.5	3	21,257	18,638	2,619	87.6
15.0	3	18,908	17,391	1,516	92.1
30.0	6	11,736	10,388	1,348	88.6
		Engine No. 1499 (Grease)			
6.7	2	22,921	18,285	4,644	79.9
13.5	4	20,035	16,452	3,591	82.1
20.0	2	18,853	15,348	3,511	81.6
26.7	4	12,824	9,654	3,171	75.3

respectively, which were also tested on the St. Louis plant in 1904. It must be remembered that the relative machine efficiencies of locomotives tested on a test plant as these were, reflect the relative frictional resistances of oil and grease lubrication, as the driving journal friction represents the major portion of the loss between the cylinder developed power and the observed drawbar pull. The machine efficiencies in road operation will be



Comparative machine efficiencies of locomotives with oil and grease lubrication—Data from St. Louis and Purdue tests

lower than those observed in test plant operation, inasmuch as they include not only the frictional resistances recorded on the test plant, but that required to move the engine and tender. However, approximately the same difference will exist between oil and grease lubrication and that difference will be lost and must be paid for by additional coal consumption, if the locomotive is grease lubricated, or can be utilized for useful work if the locomotive is oil lubricated.

The indicated horsepower, theoretical tractive force and machine friction based on an eight per cent increase in grease over oil lubrication have been figured at various speeds for typical 4-6-2 and 2-8-2 type locomotives, being arranged in Table IV. The essential dimensions of these locomotives are as follows:

	4-6-2 type	2-8-2 type
Cylinders, diam. and stroke	27 in. by 28 in.	28 in. by 32 in.
Diameter drivers	80 in.	63 in.
Boiler pressure	205	200
Tractive force	44,460 lb.	67,700 lb.

A 2-8-2 type of good design can operate on about 3 lb. of coal per i.hp. hour, while a 4-6-2 locomotive will average 2.5 lb. up to about 50 miles per hour, increasing above that point so that 3 lb. per i.hp. hour will not truly reflect conditions. The increased coal consumption, see Table IV, represents conservatively the amount required per hour to compensate for the greater frictional resistance of grease lubrication.

In concluding his report on oil vs. grease lubrication in 1906, Professor Goss said: "1,000 lb. at the drawbar, when the locomotive is developing 30,000 to 40,000 lb., is a very small percentage and it is for that reason that at slow speeds the power equivalent is small, but as the speed becomes high and the maximum drawbar force, which the locomotive can develop is reduced to 6,000 or

Table IV—Theoretical tractive force and machine friction at various speeds for 2-8-2 and 4-6-2 type locomotives

Speed m.p.h. 2-8-2	I.hp.	Tractive force	Machine friction based on 8 per cent inc. grease over oil: I.hp.	Machine friction based on 8 per cent inc. grease over oil: Drawbar pull	Equiv. increased coal due to excess grease friction: At 3 lb. I.hp. hr.	Equiv. increased coal due to excess grease friction: At 2.5 lb. per I.hp. hr.
10	1,750	65,330	140	3,920	420	...
15	2,254	56,870	180	4,550	540	...
20	2,559	47,390	205	3,790	615	...
25	2,691	40,620	215	3,250	645	...
4-6-2						
20	2,117	38,365	169	3,070	...	423
25	2,327	35,400	186	2,830	...	465
30	2,461	30,810	197	2,465	...	493
40	2,615	25,075	209	2,005	...	523
50	2,690	20,185	215	1,615	675	...
60	2,690	16,850	215	1,350	675	...

7,000 lb., then the 1,000 lb. absorbed by the grease friction in excess of that required by oil becomes relatively large."

The importance of decreased frictional resistance is greatest with passenger locomotives, as pointed out by Professor Goss, owing to the small reserve at high speeds, but it is also well worth study in its reduction as applied to heavy freight power, especially so in view of the trend at the present time from slow speed drag service to moderate and high speed capacity service. The one essential required to assure the benefits of decreased frictional loss, the attainment of greater locomotive machine efficiency is a reliable, dependable, simple and economical method of oil journal lubrication.

2-6-0 locomotive on the Dayton & Michigan in 1882—Cylinders 18 in. by 24 in., 56-in. drivers

What is the locomotive of today?

T.E.A. conducts symposium of builders and railroad officers, who discuss present motive power status and probable future developments

THE second day of the Traveling Engineers' Association convention, held at Chicago, September 14 to 17, was devoted to a symposium on the locomotive of today, in which a group of railway operating and mechanical officers and engineering representatives of the builders participated. The result was a comprehensive review of the best in modern steam locomotive development, a clear interpretation of the possibilities offered by recent developments in locomotive design and proportions, a thorough discussion of the possibilities of more effective utilization of locomotives, and a well-considered estimate of developments which may be expected in the near future. Samuel O. Dunn, editor of the Railway Age, presided and introduced the speakers, who were A. R. Ayers, assistant general manager, N. Y. C. & St. L.; O. S. Jackson, superintendent motive power and machinery, U. P.; W. E. Woodard, vice-president, Lima Locomotive Works; J. B. Ennis, vice-president, American Locomotive Company; W. L. Bean, mechanical manager, N. Y. N. H. & H.; A. G. Trumbull, chief mechanical engineer, Erie; C. T. Ripley, chief mechanical engineer, A. T. & S. F., and J. E. Muhfeld. Abstracts of the addresses by Messrs. Ayers (which was read by W. G. Black, superintendent of motive power, N. Y. C. & St. L.), Jackson, Woodard and Ennis are included in this issue. Those of the other speakers will appear next month.

In his opening address, Mr. Dunn laid in the background of the picture against which the other speakers brought out in sharper outline the many specific features of locomotive design and operation which give the locomotive of today its outstanding characteristics.

After recording some of the outstanding increases in weight and tractive force of the locomotive which have taken place during a period of 20 years, Mr. Dunn gave a more comprehensive picture of the developments of this period by presenting changes in the number of locomotives and in the average tractive force which have taken place. "On June 30, 1916," he said, "the Class I railways had approximately 48,055 locomotives. Between that date and June 30, 1916, they retired 15,570, or about 32 per cent of the total number, and installed 29,393 new locomotives. On June 30, 1916, they had 61,057 locomotives, and between that date and December 31, 1925, they retired 17,853, or 28 per cent of the total number, and installed 20,452 locomotives, which increased the total number to 63,656. The total retirements during this period of almost 20 years were 33,423, or 69 per cent of the number owned on June 30, 1906, while the number installed in service was 49,845, or 77 per cent of the total number owned on December 31, 1925. It would appear from the foregoing figures that about 32 per cent of the locomotives now in service are less than ten years old, and that about 78 per cent are less than 20 years old.

"In this constant process of retirements and installations, the average tractive force of locomotives has steadily increased. In 1906 it was 24,741 lb. for all the locomotives owned by the railways, and in 1916 it was 32,423 lb., an increase of 31 per cent. For the year 1925 we have only the statistics of Class I roads. The average tractive force of their locomotives in 1916 was 33,181 lb., and in 1925, 40,719 lb., an increase of 23 per cent. The increase in the average tractive force per locomotive during the entire period of 20 years was about 65 per cent. In other words, at the beginning of this period of 20 years, five average locomotives had theoretically only as much pulling power as three average locomotives had at the end of it."

Mr. Dunn then took up the question of the average performance which these changes had effected, using the number of gross-tons hauled one mile per train-hour as the best measure of performance. Dividing the period from 1906 into two decades and basing his comparisons on estimates of train speed in 1906 and 1916, Mr. Dunn continued: "It would appear that gross tons per train averaged in 1906 about 881 tons and in 1916 about 1,249 tons. This was a period during which the railways put forth great efforts to effect economies by increasing the average load of freight trains but did little to increase their average speed. It seems reasonable, therefore, to assume that in both 1906 and 1916 the average speed of freight trains was 10 miles. On that assumption the increase in average gross ton-miles per train hour between these years was about 42 per cent. The increase in the gross train load between 1916 and 1925 was from about 1,249 tons to 1,670 tons, or 34 per cent. The increase during this period in the efficiency with which locomotives were utilized in road service cannot, however, be measured merely by the increase in the average train load. Since the passage of the Adamson Act, and especially since the application of punitive overtime in train service, the railways have made great efforts to increase the average speed of trains, and it was increased from about 10 miles an hour in 1916 to 11.8 miles an hour in 1925. The result of the increases in the average train load and in average speed was an increase in gross ton-miles per train hour from about 12,490 in 1916 to 19,679 in 1925, or 57 per cent.

"These estimated increases of 42 per cent between 1906 and 1916, and of 57 per cent between 1916 and 1925 in gross ton-miles per train hour are, of course, attributable, first, to improvements in locomotives and increases in their tractive power, and second, to improvements in other railway physical facilities and in operating methods resulting in better locomotive utilization.

"Gross ton-miles per train hour have continued to increase this year, having in the first six months of 1926 averaged 20,196, or 5 per cent more than in the first half of 1925, and 62 per cent more than ten years ago."

In commenting on this performance, Mr. Dunn called attention to the fact that only one-third of the locomotives now in service have been installed during the last ten years, and only about 18 per cent of them have been installed since 1920. In this result he said that the designers and builders of locomotives and locomotive specialties on the one hand, and those who operate them on the railroads had participated with a generous ri-

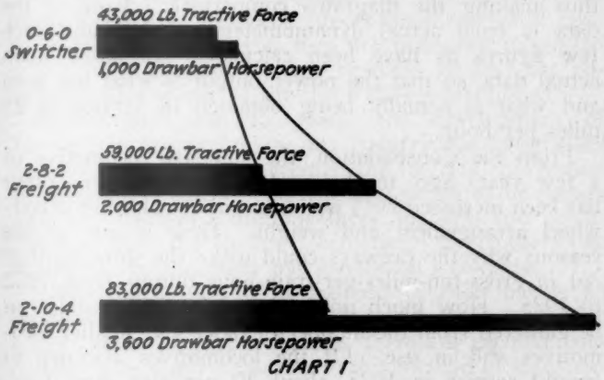
valry, and in concluding he said: "It seems not visionary to express the belief, in view of past experience and especially that of recent years, that old locomotives may in the future be more rapidly replaced with the 'locomotive of today' and that methods of locomotive utilization may be still further improved, with the result of effecting in future much greater proportionate increases in efficiency of operation and improvements of service than even those that have been accomplished during the last five years."

High horsepower output cuts operating costs

By W. E. Woodard

Vice-president, Lima Locomotive Works, Inc., New York City

Gross ton-miles per train hour gives a more reliable index than any other single figure as to the rate at which railways are moving tonnage. It may be regarded as an index of the extent to which railways are utilizing their transportation plants. The railways of the country from 1922 to 1925 increased this figure 21.6 per cent and, what is even more significant, they did this with



Comparison of locomotives of different classes

only a 7.6 per cent increase in total locomotive tractive force. This, truly, was a remarkable achievement and the members of this association in no small measure helped in the accomplishment.

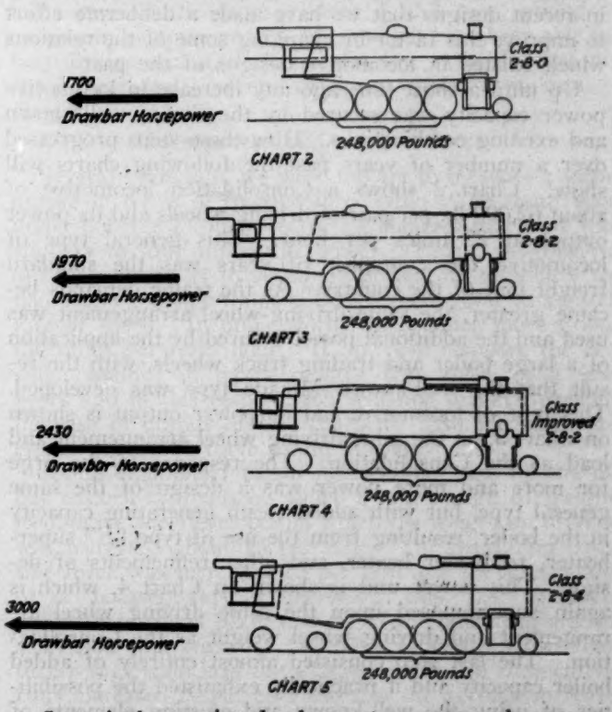
To the locomotive designer and builder this splendid record is significant because it shows that power output is becoming more and more a requirement in fitting locomotive designs into railway companies' needs. While improvements such as better signalling, improved siding and yard facilities, as well as an increase in average car capacity, unquestionably provided some of the means whereby this increase was secured, the fact remains that it could only have been accomplished by a marked increase in the average drawbar horsepower output of the locomotives.

An example from a recent road test will illustrate how tonnage and speed affect this figure: a 2-8-2 locomotive handled 1691 tons in 46 cars over about 46 miles, much of it 1 per cent up-grade, at an average speed of 14¼ miles per hour. In doing this the engine developed an average drawbar horsepower of 1150. On the same day, over the same division, a 2-8-4 locomotive handled 2296 tons in 54 cars, at an average speed of 19.9 miles per hour. The average drawbar horsepower shown on the dynamometer car was 1784. The data is absolutely comparative, because the runs were made on the same day under the same weather conditions. The heavier train at the higher speed required 55 per cent more drawbar horsepower output. These figures are mentioned simply to illustrate what the demand for increased tonnage at higher speed means in terms of power output of the locomotive. These greater requirements often mean the use of a motive power unit of a different class in order to meet the traffic conditions without a sacrifice in tonnage.

In the study of this situation, there is one element which is of special interest, namely, the allowable driving-wheel loads. For the past few years the maximum allowable driver-wheel weight has not been increased, and there is no indication that it will be materially increased in the near future. Therefore, any improvement in the locomotive must come through a more intensive production of power per unit of weight.

In considering the present-day locomotive as a "moving power plant"—which it really is, we can omit from the discussion reference to variations in detail design and focus attention on the fundamental problem, which is—How can we obtain the increased drawbar horsepower which future traffic conditions will demand within existing driver-wheel weights, always keeping in mind locomotive fuel efficiency?

In order that we may get clearly in mind the meaning of the term "drawbar horsepower," I would like to point out the difference between horsepower and tractive force. Tractive force is the pull exerted by the cylinders at the rim of the driving wheels. If we substract from tractive force the pull required to move the engine and tender, we get drawbar pull. Drawbar horsepower is the rate at which drawbar pull is produced. For example (see Chart 1), a heavy six-wheel switcher having a tractive force of 43,000 lb. can produce 33,000 drawbar



Steps in locomotive development over several years

pull at 1000 ft. per min., or 11.2 miles per hour. This equals exactly 1000 drawbar horsepower. An average freight engine having a tractive force of 59,000 lb. will produce 33,000 drawbar pull at 2000 ft. per min., 22.6 miles per hour. This is 2000 drawbar horsepower. One of our biggest freight units having a tractive force of 83,000 lb. can produce 33,000 drawbar pull at 3600 ft. per min., or 41 miles per hour. This is 3600 drawbar

horsepower. Note that the big freight engine will produce 3.6 times as much drawbar horsepower as the switcher, whereas the maximum tractive force of the big engine is less than two times as much as the switcher. The big freight unit will produce almost twice the drawbar horsepower of the average freight engine, whereas its maximum tractive force is only 1.4 times as much.

While this comparison is made between locomotives of different classes, in order to bring out clearly the relation between tractive force and drawbar horsepower, the same thing is true to a lesser degree between locomotives of the same class. Maximum tractive force is no longer an index of the capacity of a locomotive to pull tonnage over a railroad. This statement is confirmed by operating results. From 1922 to 1925 the per cent of increase in gross ton miles per train hour (21.6 per cent) was almost three times the per cent of increase in the total tractive force of the locomotives (7.6 per cent). Beyond question one large element in this result was the more extensive use of modern motive power units in which the proportion of horsepower output to tractive force is far greater than in the older types of engines. If we wish, therefore, to find the value of a locomotive design for producing gross ton miles per hour, major consideration must be given to its drawbar horsepower.

I do not want to give the impression that we have discovered anything new when we talk about increasing the drawbar horsepower output of a locomotive. However, we now realize more clearly the importance of this factor in relation to railway operation, and it is only in recent designs that we have made a deliberate effort to improve this factor by changing some of the relations which existed in locomotive designs of the past.

Up until a short time ago any increase in locomotive power capacity was secured by the use of well-known and existing combinations. How these steps progressed over a number of years past the following charts will show. Chart 2 shows a Consolidation locomotive of about 62,000 lb. per pair of driving wheels and its power output at 25 miles per hour. This general type of locomotive for a number of years was the standard freight unit of the country. As the traffic demands became greater, the same driving-wheel arrangement was used and the additional power secured by the application of a large boiler and trailing truck wheels, with the result that the well-known Mikado type was developed. This type of locomotive and its power output is shown on Chart 3, on the same driving wheel arrangement and load as the Consolidation. The response to the urge for more and more power was a design of the same general type, but with added steam generating capacity in the boiler, resulting from the use of type "E" superheater, feedwater heater, and other refinements of design. This power unit is shown on Chart 4, which is again superimposed upon the same driving wheel arrangement and driving wheel weight as the Consolidation. The last step consisted almost entirely of added boiler capacity and it practically exhausted the possibilities of using the well-known and existing elements of locomotive design for securing maximum power output on a given arrangement of driving wheels and a given driver-wheel weight.

The next step, and one which represents a number of locomotives now in use and being built, was to get more cylinder power into the same driver-wheel weight and furnish means in the boiler for supplying steam for this added cylinder power. This problem has been approached from two different angles by different builders. One method—which is now represented by 105 locomotives in use or building—is to increase the cylinder power by limiting the cut-off and raising the boiler pressure. This has the effect of keeping the maximum tractive force at about the same point or slightly higher than the older designs, but raises the drawbar horsepower at operating speeds in proportion to the increase in pressure. Such a design is shown on Chart 5, again superimposed upon the same driver-wheel arrangement and weight as the old Consolidation.

Added cylinder power output also can be secured by the use of three cylinders with a boiler of sufficient size to supply the cylinder requirements. The result is a similar increase in drawbar horsepower output.

In these comparisons the part played by the boiler in increasing the power output is very apparent, and it is only through higher boiler capacity that cylinder power output can be increased. To the locomotive designer the problem of securing greater capacity in the cylinders is relatively easy; the real problem is to get boiler capacity to supply the increased cylinder requirements.

In this comparison of the four locomotives all upon the same driver-wheel arrangement and driver-wheel weight, I have used actual locomotives and eliminated the variable of driving-wheel load and arrangement, thus making the diagrams comparable. Most of the data is from actual dynamometer car tests and such few figures as have been calculated are based upon actual data, so that the power output is what has been and what is actually being obtained in service at 25 miles per hour.

From the Consolidation, the standard locomotive of a few years ago, to the modern 2-8-4, power output has been increased 76½ per cent without altering driver-wheel arrangement and weight. Here is one of the reasons why the railways could make the showing they did in gross-ton-miles-per-train-hour output from 1922 to 1925. How much improvement is still possible can be gathered from the number of older and smaller locomotives still in use. Of the locomotives assigned to freight service in 1925, about 40 per cent were Consolidations, almost all of them less powerful than the Consolidation I have shown in the diagram; 22½ per cent of all the freight power in 1925 were of the Mikado type, many of them not as powerful as the Mikado I have shown. With all due allowance for the needs of branch-line and pick-up service, these figures reveal the possibility of savings in operation by the substitution of new and improved motive power units.

The comparison has been made upon freight power, as the advance could be more easily traced in the classes of locomotives used in this service. The same principles of increase in power output are applicable to passenger locomotives, but in this line we do not seem to be as far advanced as we are in the locomotive for freight service.

I have confined myself to this rather elementary talk on locomotive power output because of the following reasons, which are a summary of what I have said:

A study of traffic figures clearly reveals a strong trend toward more tonnage at higher speeds; this means more gross ton mile output per train hour, which results in increased demands for power output from the locomotive units.

The allowable driving-wheel loads have remained and probably will remain about stationary. Logically, therefore, the line of progress is to get the greatest amount of power obtainable out of the existing driver-wheel loads.

The diagrams show what already has been done. "The Locomotive of Today" is being made to fit the operating conditions now being developed on the rail-

ways and such a locomotive can briefly be described as follows:

For a freight unit of 60,000 lb. axle load, a locomotive which will develop from 3,000 to 3,600 drawbar horsepower with a boiler of sufficient size to generate steam for this output at combustion rates of not over 100 lb. of coal per square foot of grate per hour. For lighter axle loads, a drawbar horsepower output in proportion to the allowable wheel loads, the maximum combustion rate remaining at 100 lb. of coal per square foot of grate.

This sounds simple. There are a few locomotives running which meet these requirements. This specification stands for the best freight units of the present day.

Reliability, high horsepower and economy

By J. B. Ennis

Vice-president, American Locomotive Company, New York

We have at the present time, three distinct classes of locomotives, steam, electric and internal combustion. Since the advent of railroading in this country, the steam locomotive has been predominant, and still continues to be. While you men are primarily interested in the steam locomotive, it is needless to deny the advantages of any one of the three classes mentioned.

Within the past 25 years, the development of the electric locomotive in this country has progressed steadily and still, more recently, the internal combustion locomotive has entered the field and promises to remain with us. Certain conditions favor for safe and profitable operation the electric locomotive. Still others can be more advantageously met by the oil locomotive.

The electrification of a railroad division means an enormous investment as compared with steam operation which cannot be justified unless there are peculiar conditions particularly favorable to this method of transportation. Even then, the probable economies should be thoroughly investigated to make sure that the financial return will not be in doubt. Careful consideration should also be given to the possibilities of economizing and obtaining greater capacity by the use of improved steam locomotives where the investment would not be so great and the results can be forecast with reasonable accuracy. Unfortunately, comparisons have been made to prove the superior economy of electrification where they have been based upon steam operation with locomotives of old design, and in many cases, very light power. The modern steam locomotive has shown such an improvement in productive capacity and economy, even over locomotives of ten or fifteen years ago, as to warrant its continued use for many years to come for the general service of our railroads.

There are many difficulties in the way of providing an internal combustion locomotive to replace the modern high powered steam locomotive, although, ultimately, the problem will be solved if there is sufficient demand, and if it appears to be an economical necessity. Until this is done, large power in this class can only be obtained by the coupling together of two or more smaller units, and the use of multiple control, which is entirely feasible. Our experience so far with this class of power has been confined to comparatively small units, mostly for switching service. Locomotives are now being built for branch line service of somewhat higher power and designs are being prepared for still larger units.

All of the oil locomotives so far built in this country for railroad operation have been constructed with electric transmission. Experiments are being made, both here and abroad, with other forms of transmission, such as hydraulic and mechanical, and the question of the most satisfactory drive is only one of the many problems yet to be solved. The great advantage of such a locomotive lies in the economy of fuel, the elimination of the boiler with its maintenance troubles, and the possibility of almost continuous daily use.

Thirty years' growth in capacity

Coming now to the steam locomotive, I would like to read a paragraph from the proceedings of the Western Railway Club of March, 1894:

"The most encouraging thing, I think, that we have in the matter of compound locomotives, is the report from the Pennsylvania road, where they show at 70 miles per hour they have developed 914 horsepower. . . . . It is the greatest horsepower, I think, that has ever been reported at such a high speed."

That evidently represented a maximum locomotive of that time from the standpoint of horsepower. A few years later, in 1906, the statement was made at one of our Eastern railroad clubs by an earnest advocate of electric traction that electric locomotives then in service had developed a horsepower at the wheels of 2,500 to 3,000, something that never could be accomplished by the steam locomotive. Today, we have clearances very little in excess of those of thirty years ago, and yet our steam locomotive is a machine that develops more than 3,500 indicated horsepower. In fact, one of our largest freight road locomotives recently built developed in excess of 4,700 indicated horsepower.

We have reached 96,600 lb. tractive force in a simple locomotive of the three-cylinder 4-12-2 type, giving a maximum horsepower of 4,750, and yet have been able to keep bridge and track stresses as low as in the case of smaller and less powerful machines operating in similar service.

Horsepower vs. tractive force

Several years ago, we were too apt to measure a locomotive in terms of tractive force only. The result was under-boilered locomotives, or locomotives that were too slippery to fully utilize the power. Today, we concern ourselves more as to sustained power or the ability to take heavy tonnage trains and keep them going at a good rate of speed. In other words, to produce more gross ton miles per train hour. If you will compare the results obtained in recent months with those of a few years ago in this respect, you will find a much greater increase in output of this character than the mere increase in tractive force would indicate.

As an example, I might mention the case of one of our eastern railroads on which a new design of freight locomotive was developed in which the weight on drivers was increased about 13 per cent. The maximum tractive force was increased 23 per cent and the application of a booster further increased this. A comparison with previous performances of the older engines on a division approximately 140 miles in length shows that the average train load for a larger number of consecutive runs increased 29 per cent and that the average increase in gross ton miles per train hour was 78 per cent. In other words, for a 13 per cent increase in weight on drivers an increase of 78 per cent was obtained in the productive capacity of the locomotive. Even this statement does not really indicate the full advantage obtained as the locomotive mileage per month in this service has reached figures never before realized.

Recent fundamental improvements

Among the fundamental improvements recently made in this country in the steam locomotive through the co-

operation of the motive power officers of the roads and builders might be mentioned the following:

Application of three cylinders, both simple and compound.
High boiler pressure now reaching 400 lb. per sq. in.
Limited cut-off.
Higher temperature superheaters.
Water tube fireboxes.
Large tenders.
Twelve coupled locomotives.
Improvements in details tending to give greater reliability with less maintenance.
Improvements in counterbalance and other conditions making for lower rail stresses.

As builders, we have been constantly aiming to advance the art. Each builder has his own ideas as to the particular characteristics of design that will best fit certain conditions and provide the most efficient machine. Each one has demonstrated under certain conditions that his theories were correct. Each builder is trying to put out the best that he knows how from a designing and construction standpoint, in order to provide the maximum of efficiency, economy and serviceability.

The builders have, in a few cases, brought out for experimental purposes single locomotives designed with the thought of providing increased sustained power, greater economy in fuel, and greater reliability in service. These have demonstrated the possibilities of reducing operating costs through the replacement of obsolete and inefficient power.

A little more than three years ago, we were confronted with the problem of providing, in a given case, considerably more power within certain restricted clearances and weights than had been previously possible. At that time, there seemed to be only one way out of the difficulty and that was the introduction of a third cylinder. There were many obstacles in the way, but we felt that the trouble heretofore experienced with this class of locomotive could be overcome. The first application was on an existing locomotive, and while the cylinders were made 3 in. smaller in diameter than in the case of the two-cylinder engine the maximum tractive force of the engine was increased from 54,000 to 64,500 lb. The same size boiler and firebox were utilized, and in order to provide for better steaming qualities and higher superheat a new design of superheater was installed.

Since the completion of this first locomotive, we have furnished a total of 141 locomotives of the three-cylinder type. A considerably larger number are in successful service abroad. The performance of these locomotives has proved to our satisfaction that in general for the same weight on drivers, an increased hauling capacity can be obtained, varying from 11 to 20 per cent. The advantages, other than the increased power, are better balancing, better steaming of the boiler due to six exhausts instead of four, lower piston thrusts, fuel economy, and better effect on track. The maintenance costs, so far, do not indicate any appreciable higher amounts than those of corresponding two cylinder engines.

Thermal efficiency must be improved

The steam locomotive must be improved from the standpoint of thermal efficiency, in order to remain as it is at present—predominant in its field. Even though most of the locomotives now in service in this country are of the two-cylinder single expansion type, this does not mean that the steam locomotive of the future must be of that type. The fact that many years ago we tried compounding, and discarded it because of its complications, does not necessarily mean that we must be content with single expansion for the future. As a matter of fact, most of the fuel saving devices in use today were tried many years ago and many were discarded because the fuel economy realized at that time did not warrant the expense of arranging for systematic maintenance. This condition is different today. The high cost of fuel has made it of the utmost importance to devise some more efficient method of producing and utilizing steam for power purposes.

This has been particularly true abroad. Probably the most outstanding developments in Europe have been the use quite recently of high pressures, going up to 840 lb. per square inch, and the use of turbine condensing engines with moderately high pressure. Other features now being tried are uniflow cylinders, improved valve gears and poppet valves. Out of this experimental work will, undoubtedly, come some one or more successful fuel-saving systems that will not subtract from the general reliability of the locomotive and its fitness for continuous service, nor will it add materially to the maintenance cost.

In this country, we are reaching for higher pressure. We have built one locomotive having 350 lb. pressure for the Delaware & Hudson, and are building another which will have 400 lb. pressure. The one in service has shown very satisfactory fuel records and, so far, without any excessive maintenance cost. It is of the two-cylinder cross compound type with water tube firebox. We must look to the very high pressure boiler as a source of economy in fuel, and, undoubtedly, great strides will be made in this direction in the near future. Other methods of steam utilization may come with it in order to obtain greater economy.

While we are always striving for better things, we need not be ashamed of coal records from existing steam locomotives showing better than 2 lb. per indicated horsepower-hours and steam records of better than 16 lb. per indicated horsepower-hour. These are the results of refinement in design, of improved material, and better construction, and yet with all of this refinement we do not need to find excessive complications and high maintenance. We have freight locomotives today giving better than 9,000 miles per month in regular service and passenger locomotives giving still more.

Other things needing improvement

Features of lubrication are now being well looked after on our locomotives better than ever before. We must realize a machine of great power operating under the conditions that exist on the railroads of today must be well lubricated in order to remain in motion. Too little attention has been given to this in the past and there is yet a great opportunity for improvement in this particular field.

Some advance has been made in the use of better materials for locomotive details. And, yet, there is probably no one item that will need more attention than this, in the future. We have had entirely too many failures of important locomotive forgings, taking out of service locomotives that otherwise could have been utilized. While we must have materials that will give us minimum weight, still more important is the material that will last until worn down to the safe limit.

In slow speed service where the demands on the boiler are not great, a locomotive having a high percentage of weight on drivers, such as the Consolidation type, has worked out very satisfactorily. Where speed is an important consideration, combined with high sustained drawbar pull, greater boiler capacity is required, and we often find it impossible to obtain this within the allowable limits of driving wheel weights without resorting to trailer trucks. The quality of fuel determines the amount of grate area. No fixed standards can be ap-

plied. Large grate areas are essential in some cases to insure economical rates of combustion. Standby losses must be considered, however.

The steam locomotive is still handicapped to a large extent by too much back pressure caused, in some cases, by too small boilers or fireboxes, and also due to other factors. In order to improve this condition, experiments have been made with fan draft and while, so far, the results obtained have not warranted any general adoption of this method of producing draft, there is ample field for development work in this direction with promise of satisfactory results.

More attention than ever is being given in the design of locomotives to the convenience and safety of cab fittings and the comfort of the engine crew. The importance of this is fully realized, especially on large power, and recent reports from enginemen indicate that this is being accomplished in a satisfactory manner.

The steam locomotive of tomorrow

What of the steam locomotive of tomorrow? And how will it differ from the one we have today? Materially higher pressures will be used without any sacrifice of safety, and with greater economy. Reciprocating engines will be used until turbines prove their superiority which, if they do, will take considerable time. Valves and valve gears may be changed in principle from what we are now using, and the steam produced more economically will have to be utilized more economically. Two and three cylinders will be used, both simple and compound, and the possibilities of limited cut-off will be further developed. Superheat will be increased. Back pressure will be reduced; better materials will be used; maintenance will be systematic, not spasmodic, and the locomotive designed so that running repairs can be quickly and easily made, and general repairs only after satisfactory mileage has been obtained. Better means of lubrication will be provided so that in all, greater economy and reliability will be produced and the records of today, good as they are, will be eclipsed by those of tomorrow.

The railroads will decide, after all, just what the locomotive of tomorrow will be. The builders are prepared to develop and build it for them. You men have a great influence in determining the answer to this problem. The successful utilization of the locomotive depends, in a large measure, on you. While the builders are striving for increased efficiency, it can only be realized by zealous effort on your part in perfecting the technique of operation. On you devolves the duty of instruction in approved methods, if maximum economy of operation and maintenance is to be attained. Without your co-operation, the most efficient product of the builders can make only an indifferent showing. Your assistance has been of great value to us in the past and we now ask that it continue so that we may build as the locomotive of the future only that which represents the ideal from the standpoints of safety, minimum stresses on track and bridges, maximum output per unit of time, low fuel cost, low maintenance cost, and convenience and comfort for the engine crew.

Improved operating methods

By A. R. Ayers

Assistant general manager, New York, Chicago & St. Louis, Cleveland, Ohio

Freight of all kind is moving today at higher speeds than ever before, and in order that operating costs may be cut down, this freight must be handled in large train units. These things require a steam locomotive that will develop a great amount of power at high speed.

How well the builders and designers are meeting these conditions is shown by a comparison of a recent Mikado with one built in 1913; the later engine has only 17 per cent more total weight, but is about 40 per cent stronger at the start, 40 per cent at 20 miles per hour, 60 per cent at 30 miles per hour and develops 60 per cent more maximum cylinder horsepower. It will do nearly 60 per cent more work per pound of coal than the early design.

The locomotive today will run about twice as far between general repairs as it would 20 years ago, and the liability of failure is very much less. Machinery parts, including cylinders, wheels, rods, frames, etc., have been lightened and strengthened by better design, and the use of high quality steels, and the weight saved in this way has been put into better boilers and fuel saving devices. New features are being developed constantly, and by continued attention to these things we can increase the capacity of the locomotive, increase the mileage between shoppings and cut down the amount of attention required in the meantime.

Correct use one of the greatest problems

Assuming that the engine is well designed and built and maintained, all of which is pretty well done today, there remains the great problem of using it to the best advantage. Traveling engineers and traveling firemen may play a most important part in developing the loading and operating of modern high-powered locomotives to take full advantage of their capacity and economy. In doing this they may, of course, receive much benefit from the locomotive and specialty service men who are experts in their particular lines.

We spend considerable money for devices that will save 10 to 25 per cent of the fuel, but it is a fact that can easily be demonstrated by actual test that poor firing or working the engine with wrong throttle and cutoff may easily waste from 10 to 15 per cent of the fuel. Light loading of trains is perhaps even more wasteful.

Four items that vitally affect the capacity and economy of the steam locomotive are cutoff, throttle opening, back pressure and draft.

If a steam locomotive is worked beyond 35 per cent to 40 per cent cutoff, the consumption of steam increases far beyond the proportionate increase in power; in other words, the engine becomes wasteful of steam.

Economies produced by two-cylinder limited cutoff engines and three-cylinder engines which are brought about partly, at least, by working steam at considerably shorter cutoff than ordinary practice, have caused us to run a number of tests to determine whether our locomotives are being operated at or beyond the point of economical cutoff. During these tests the engines were operated under full throttle practically all of the time.

On some of these runs, it was found that the cutoff was over 40 per cent about seven-eights of the time, and on one run, which was a fast heavy tonnage train, the engine was worked over 50 per cent cutoff 89 per cent of the time; these engines were U.S.R.A. Mikados equipped with feedwater heaters and boosters.

To carry the tests further, the cylinder diameter on one engine was increased from 26 in. to 27½ in., and the maximum cutoff with reverse lever in the corner reduced from 90 per cent to 75 per cent. Handling trains of practically the same weight and speed as another engine of the same class, the modified engine was over 40 per cent cutoff only 39 to 43 per cent of the time, compared with 86 to 88 per cent of the time for the standard engine, and the modified engine showed only 3 per cent to 9 per cent economy in fuel and about

the same in water; the saving was, of course, greater on heavier trains.

The need for improved drafting

Much remains to be accomplished in developing means for producing the necessary draft on a locomotive without so much sacrifice of power due to back pressure.

The importance of back pressure is, of course, recognized, but may be emphasized by the statement that one pound of back pressure on a locomotive with 26-in. by 30-in. cylinders and 63-in. drivers at 35 miles per hour is equivalent to about 30 hp.

Somtime ago two Mikados were equipped with a device for automatically controlling cutoff according to back pressure, and these engines demonstrated that where maximum power is required there is considerable gain in power as well as economy by working with full throttle and with cutoff adjusted to keep the back pressure within reasonable limits. These limits will, of course, vary according to the type of engine, kind of fuel, etc.

Since that time, a number of locomotives have been equipped with back pressure gages, and the enginemen seem to be glad to have such gages on their engines, because the modern locomotive is so large that it is difficult for the engineer to operate it to the best advantage when relying only on his judgment assisted by the sound of the engine.

Feedwater heating devices in operation will reduce back pressure from 2 lb. to 4 lb. and on engines with large grates, automatic stokers, by carrying a thin, even fire, make it possible to get the maximum boiler capacity with less draft and consequently less back pressure than would be needed with heavy fires.

On large engines, the plain round exhaust nozzle does not appear to give as much draft per pound of back pressure as some form of nozzle which breaks up the exhaust jet and in this way provides more entraining surface for the front and gases.

Results of improvements in the locomotive and in operating methods

This is a subject of first importance in connection with locomotive operation today, and to show how far it can be carried it may be stated that engines which were formerly operated with 5¾ in. plain round nozzles are now in successful operation with specially designed nozzles having an area equivalent to a 6½ in. plain round, resulting in considerable increase in power, without any sacrifice of steaming qualities.

On one division where the size and type of freight power has been unchanged for four years, except that some of the later engines are equipped with boosters and feedwater heaters, the average tonnage per freight train in the direction of heavy traffic has been increased 360 tons with an increase in speed of about ¾ miles per hour. This figure is quoted to show what can be done partly by application of betterments and partly by attention to train loading and best methods of operating the locomotives.

Many notable examples of long engine runs on freight trains, as well as passenger trains, have been published in recent months. The modern locomotive is entirely capable of running several hundred miles on either passenger or freight trains without repairs, and the advantages of this practice are so many that there seems to be no doubt that it has come to stay, not only for oil-burners but also for coal-burners.

Among the advantages are the saving of fuel, otherwise wasted at terminals; saving in cost of terminal handling; better maintenance; more serviceable engine hours, and last but by no means least, the general speeding up of freight train operation through the elimination of most of the delays waiting for power, and the consequent incentive to the transportation department to make up its trains and handle its terminal yard work so as to take full advantage of the through runs.

As far as maintenance is concerned, the long runs force good maintenance, and at the same time make it easier, because long runs generally carry with them longer lay-over periods which afford plenty of time to do the necessary work on the engine, and this time is not always available on short runs with quick turns.

Some progress has been made with locomotives of this type in Europe, but not much in this country on account of cost and the large size of locomotive involved.

The use of much higher boiler pressures with some form of water tube boiler construction appears to offer one of the most attractive fields for radical changes in steam locomotive design in the near future.

Discussion of the locomotive today would be incomplete without reference to electric and internal combustion locomotives. Both of these systems have the advantage of very high starting power and more serviceable hours per locomotive per day. In addition, the internal combustion engine has a lower fuel cost than the steam locomotive, and the electric locomotive is apparently somewhat cheaper to maintain, although somewhat restricted in its field of operation, on account of requiring trolley wires or third rail. The steam locomotive, however, still holds the great advantage of much lower first cost, and is making great strides in fuel economy and starting power.

No doubt all three of these systems will continue to develop rapidly according to the demands of the service in which they operate.

Provide modern power and use it intensively

By O. S. Jackson

Superintendent of motive power and machinery, Union Pacific

In the year 1903, on a representative division of the road with which I am connected, the heaviest freight locomotive of that period had a ton-mile-hour capacity of 13,500. Today the 4-12-2 three-cylinder locomotive, termed the Union Pacific type, develops on that division a ton-mile-hour capacity of 80,000. Thus, in a period of 23 years, the locomotive unit in that territory has increased its earning capacity in a six to one ratio.

The physical characteristics and limitations of most American railroads are today rather definitely fixed, because further property extensions in extra main line track, grade revisions or extensive terminal enlargements are usually financially prohibitive.

Facilities for increase in traffic capacity when the necessity arises, must therefore follow the line of least economic resistence, which requires that a given mileage of rail shall be made to carry its maximum number of gross tons each hour of the day, before additional rail mileage is permissible.

If we review the past 20 years of rail transportation with this thought in mind, we are forcefully impressed with the very large increase in traffic volume that has taken place, compared with the relatively small increase in railroad mileage in the same period of time. The principal elements involved in this intense development are larger cars, faster movement and more powerful locomotives. Relatively speaking, locomotive unit power which embraces the element of faster movement, has grown much the more rapidly during this period. The steam locomotive has therefore contributed as a large

factor in the growth of modern rail transportation.

Recent design development

Realizing that the conventional two-cylinder locomotive has about reached its practical limit of size, weight and hauling capacity under present road limitations, locomotive designers have recently brought into the field at least two outstanding proposals for increasing hauling capacity without increasing axle loads, total weight or clearances.

I refer to the restricted cutoff locomotive, and to the three-cylinder locomotive—both of which types have made gratifying progress, and in a sense are based upon the same fundamental idea that the adhesive ratio may be reduced and more piston thrust employed, if a more uniform torque is introduced. And as both types also employ higher average rates of steam expansion than previous simple engine types, there is an attendant economy in fuel and water at the cylinders in addition to the extra power output.

These two locomotive types appear to offer at the present time the broadest and surest field for immediate progress in improving the steam locomotive, although I should not forget to mention a recent trend in locomotive boiler development that appears to carry fine possibilities for improvement in capacity, weight, higher pressure, maintenance and safety—namely, the water tube locomotive boiler in its several recent designs. I predict, however, that the water tube boiler will have to fight hard for recognition and approval, owing to our fixed conception and prejudice in regard to what really constitutes a locomotive boiler.

To my knowledge, with the exception of one isolated attempt many years ago, no one has, until quite recently, attempted to couple more than five pairs of driving wheels into one system. It seems obvious that to do so in combination with two outside cylinders would be to invite serious mechanical troubles, if not entire failure because outside cylinders of such large diameter would be required that their piston thrust could not be successfully transmitted through one main rod and one main pin and axle to six or more connected driving wheels.

The successful introduction of the three-cylinder locomotive in three, four and five coupled types has brought about, quite conveniently, a new possibility which did not exist before, and I refer to the conception of one of our mechanical officers resulting in the 4-12-2 or Union Pacific type three-cylinder locomotive with six coupled driving axles. As the middle cylinder drives the No. 2 or crank axle, while the two outside cylinders drive the No. 3 axle, a design is obtained where the driving stresses are divided up in a manner permitting better distribution of the load through frames, sides rods and crank pins, than can be obtained in the usual 2-10-2 type with outside cylinders. The sixth or additional axle permits a 20 per cent increase in traction; the third cylinder permits the use of a lower adhesion factor resulting in a 20 per cent increase in traction per axle. Thus, compared with a 2-10-2 two-cylinder type locomotive, 44 per cent increased tractive force is secured without increasing the unit axle load a single pound.

In May of this year, a locomotive of this type was delivered by the American Locomotive Company, and subjected to a rigorous practical operating test to determine its capacity, mechanical performance, and approximate fuel performance, looking toward establishing the type for additional heavy freight power in the mountain territory, if successful.

A carefully conducted fuel, water and indicator test of a month's duration has since been made and the report of this latter test is now being prepared, and will be available shortly for those who may be interested in the performance of this new type locomotive. Fourteen additional locomotives of this type have recently been delivered to our lines.

Results obtained with three-cylinder locomotives

It is the largest and most powerful non-articulated locomotive and when it was being tested it pulled the same tonnage as our Mallet locomotives on the 1.55 per cent grade between Cheyenne and Laramie at increased speed and reduced fuel consumption. On the 0 8 per cent grades between Laramie and Evanston, this locomotive, in comparison with the Mallet type demonstrated its ability to produce 80 per cent more ton miles per hour than the Mallet, both engines having equal starting tractive force. It has demonstrated its ability to produce these results on slightly less than half the Mallet fuel per thousand gross ton miles. A 48 per cent cutoff has been maintained at 42 miles per hour, developing 4,750 hp. at that speed.

This engine has successfully hauled 3,500-ton fast fruit trains between Wahsatch and Laramie, over four Districts (a distance of 361 miles) at an average running speed of 27.4 m.p.h., thereby earning one and one-third million gross ton miles per continuous trip in 18 hrs., 48 min. total time, or 13 hrs. and 15 min. running time, and while this performance was over a territory having many grades of 43 ft. per mile, the average coal consumption was 62 lb. of dry coal per thousand gross ton miles.

The question of obsolete locomotive

If we are to judge the future development of the steam locomotive by past experience and knowledge, we must admit that the possibilities for improvement in design, capacity and performance in the future are equally as good as they have been in the past. All classes of men today, dealing with the locomotive, are more highly educated and more highly trained than in the past. We have the knowledge of the past as a ground work for the future. The old cut-and-try methods of the early days have given place to scientific analysis and test work, thus avoiding a great deal of useless effort and expense.

The future appears to offer at least two very prolific lines of economic advancement in locomotive development and operation, either of which, or combined, will, if adopted, bring about remarkable economies. I refer, first, to the obsolescence of old light and uneconomical locomotives; and second, to the intelligent and maximum utilization of legitimate locomotive power. It is understood that I am speaking in general or average terms, realizing the exceptions that must be made to cover certain operating conditions; however, wearing out antique power is an expensive luxury on any railroad.

In general, there are on American railroads today, many small old locomotives, with low boiler pressure, saturated steam, low hauling capacity and high unit maintenance, that should either be equipped with modern economic devices and confined to service where they will meet the traffic conditions, or, if this is not done, should be relegated to the scrap heap.

The last several years have seen a very remarkable development in the steam locomotive as a thermal machine, not to mention the increase in unit capacity. These new types can be conservatively rated to develop each horse power on one-half the fuel and water used by old saturated power. Can the railroads afford to keep

obsolete power in service? Surveys of this light power should be made to determine upon which side of the ledger such locomotive power finally falls. With the substantial economies of lately developed types of super-locomotives well established and before us, we are in possession of the necessary elements to estimate the balancing point of obsolescence of old power, and no fear, sentiment or favor should prevent obsolescence where the answer is obvious. We can no more afford to perpetuate this obsolete power on the railroads than to perpetuate obsolete machine tools in the shops.

Long locomotive runs

The second development to which I have referred, namely, the best utilization of locomotive power, becomes a separate and different problem for each railroad property. It goes without saying that any increase in service hours of a locomotive is a direct financial gain. Undoubtedly one of the foremost factors in gaining service hours is the increase of mileage per month per locomotive through means of long locomotive runs. For example, on the road I am connected with we are today, during our peak business, getting from 35 to 40 per cent greater mileage out of our heavy freight power than was possible when locomotives were assigned to engine crew districts.

In March, 1921, we started operating passenger locomotives 225 miles over two districts, between North Platte and Cheyenne. A year later passenger locomotives were operated 284 miles, over two districts, from Council Bluffs to North Platte. Later North Platte was cut out resulting in a 509 mile run from Council Bluffs to Cheyenne.

Long locomotive passenger runs are established as follows:

Council Bluffs, Iowa	to	Cheyenne, Wyoming	509 miles
Council Bluffs, Iowa	to	Denver, Colorado	562 miles
Cheyenne, Wyoming	to	Ogden, Utah	483 miles
Denver, Colorado	to	Ogden, Utah	577 miles
Denver, Colorado	to	Kansas City, Missouri	642 miles
Cheyenne, Wyoming	to	Salt Lake City, Utah	519 miles
Cheyenne, Wyoming	to	Pocatello, Idaho	552 miles

These runs are operated with Pacific type or Mountain type locomotives depending on the grade conditions to be overcome.

In freight service are the following established long runs:

Omaha, Nebraska	to	North Platte, Nebr.	284 miles
North Platte, Nebr.	to	Cheyenne, Wyoming	225 miles
North Platte, Nebr.	to	Denver, Colorado	278 miles
Kansas City, Kansas	to	Ellis, Kansas	303 miles
Ellis, Kansas	to	Denver, Colorado	337 miles
Laramie, Wyoming	to	Green River, Wyoming	251 miles
Green River, Wyoming	to	Ogden, Utah	176 miles

These long locomotive runs have all been successful from every standpoint, and the following benefits have been obtained:

Twenty-five percent less locomotives required to handle an equal amount of traffic.

Reduction in enginehouse expenses per locomotive mile.

Reduction in consumption of fuel and supplies by eliminating layover at intermediate terminals.

Reduction in running repair charges per locomotive mile.

Maintenance costs for repairs of facilities at intermediate points greatly reduced, if not eliminated entirely.

Expenditures for additions and betterments at intermediate terminals to meet expansion of business avoided.

Reduction in mileage of engine crews taking locomotives to and from the enginehouse.

Engine failures materially reduced as a result of more thorough inspection and repair facilities at main terminals where a more systematic and uniform plan of maintenance can be executed.

Length of time to get trains through intermediate terminals greatly reduced.

To successfully operate these long runs, the engines must be kept in first class serviceable condition, and in our experience we have found the periodical locomotive repairs at terminals, as outlined some time ago in the railroad journals, has been an important factor in making this a success.

A very striking example of locomotive utilization has recently come under my observation in the standardization of locomotive running by means of the Duplex back pressure and initial pressure gage. The subject has been covered in a recent article in the railroad press, but it is pertinent to direct your attention to our experience, where a careful survey disclosed a startling variation in the individual habits employed by different enginemen, resulting in wide variation in fuel and water economy and time over the road. The operating gage is now standard on all our road engines, and I can recall no single instance in my railroad experience where such substantial economy has been obtained with so small an expenditure.

Fuel organization separate unit

Essentially in the operation of the modern locomotive cost of operation is an important factor. Nowhere is greater opportunity offered to economize than in the consumption of fuel. "Save a shovelful of coal" is a slogan that most of the larger and more progressive railroads have adopted.

On our line we have an aggressive fuel organization reporting direct to the general manager, working hand in hand with the mechanical and other departments to accomplish the greatest good. While I appreciate that most operating and mechanical men are of the opinion that fuel men should report directly to the mechanical organization, I think our results have demonstrated two things. First, that we have entirely eliminated the possibility of fuel men not getting results through their being dominated by master mechanics or other mechanical officers, to the extent that engines are permitted to go into service that are not in condition to handle maximum tonnage economically. Second, that a fuel organization composed of practical men is available to the operating department to check operating problems that are not directly connected with the mechanical organization.

Another feature is that where enginehouse foremen, district foremen and others understand that these fuel men are sending engines back to the house that are not in condition, there is less of a disposition on their part to take chances.

Our fuel organization has not only interested itself in the matter of saving fuel but we have practically eliminated fires due to defective front ends and defective ashpans through the activity of the fuel organization working with the mechanical department along these lines.

While the foregoing is perhaps a radical departure from the views of most mechanical men, we are strongly of the opinion that this is the proper organization and that we have made a practical demonstration of the comparative efficiency of the two methods that have just been briefly described.

The best utilization of locomotives also requires a systematic maintenance of the power, as the locomotive of today cannot be expected to produce maximum economy and performance unless maintained in the best of condition. It would seem to be the imperative duty of the men in your organization to not only see that enginemen are properly and thoroughly trained in their present day duties, but they should check and know the power and when not found in good condition, locomotives should be returned to the mechanical forces and not be permitted to run with resultant waste of fuel, loss of time and engine failures.

Traveling engineers' program has broad appeal

Big improvements shown in the motive power unit and in utilization of its potential capacity

THE inclusion in the program of the thirty-fourth annual meeting of the Traveling Engineers' Association of a symposium on The Locomotive of Today, participated in by railway operating and mechanical officers as well as by officers of the builders, makes the proceedings of this convention of interest not only to the traveling engineers themselves, but to all operating and mechanical department officers having to do in any capacity with the design, maintenance, operation or utilization of railway motive power. Extended abstracts of the papers presented in this symposium, which occupied the sessions of one entire day, will be found on another page of this issue.

Reports and papers which were presented and discussed during the other three days of the convention dealt with smooth train handling; locomotive availability; the growing job of the traveling engineer; the booster; automatic train control, and instructions for new firemen. The convention was also addressed by Interstate Commerce Commissioner Frank McManamy and by A. G. Pack, chief of the Bureau of Locomotive Inspection of the Interstate Commerce Commission, the address of the latter dealing extensively with the problems of utilizing autogenous welding in locomotive maintenance. In a brief address, Thomas H. Carow, chairman of the Safety Section, American Railway Association, commented briefly on the program of that section for a 35 per cent reduction in accidents by 1930 and appealed to the traveling engineers to co-operate with the Safety Section in making this goal. Mr. Carrow's address was preparatory to a definite program whereby road foremen of engines, trainmasters and master mechanics are to assist in the development of the Safety Section program for accomplishing this result.

The convention was held at the Hotel Sherman, Chicago, September 14, 15, 16 and 17, with J. N. Clark (Southern Pacific), the president, in the chair. Following the customary opening exercises, President Clark addressed the convention. His remarks are given in abstract below.

President Clark's address

During the past year it became my pleasant duty to select two committees from our membership to co-operate with the American Railway Association's committees on Locomotive Utilization, and Locomotive Construction and Design. Invitations have been extended to the chairman and members of those committees to attend our convention. The very friendly attitude of Mr. Aishton and other officers of the American Railway Association is, I am sure, very much appreciated by this association.

The responsibility of the traveling engineer increases with the ever increasing demand for better transportation. Coming within our immediate supervision is a vast army of 133,000 locomotive enginemen and firemen who look to us for education, guidance and inspiration. Our managements look to us for expert advice on everything that pertains to the modern locomotive, proper distribution of power to serve the industry best, advice upon all new locomotive appliances, fuel economy and smooth train handling to insure a safe and on-time performance.

There is only one way through which we can render satisfactory service, and that is through education, and what a wonderful medium we have, to acquire education through our association. There is not a member who has not had many of his most troublesome problems solved by having them discussed at our annual gatherings. Grouped in the next room is the finest and most complete collection of modern locomotive appliances ever assembled, and each device is presided over by an authority who is not only willing but anxious to impart to you the knowledge he has gained through intensive study.

Seven new records were established by the railroads of the United States in 1925. Included in this remarkable performance are several records over which the traveling engineer has direct supervision. Are we not, therefore, justified in feeling proud of these accomplishments? Our records mean nothing to Mr. Aishton; he makes them today, only to break them tomorrow.

But don't you get a "kick" out of breaking records? Let us pick up enough new ideas during the next four days to go home and smash all the records he can put up for us to shoot at during the next 365 days.

Progress means going forward and civilization has shown the greatest progress where transportation has been developed to its highest efficiency. China, with a population of 400 million, has less than 7,000 miles of railroads to serve its four and a half million square miles of territory, while the United States, with a population of 116 millions, has over 250 thousand miles of railroads to serve its three million square miles of territory. Transportation has been the big civilizing influenc in ours, and every other country, and we should feel a just pride in our contribution to such an industry.

Election of officers

In addition to the addresses and technical numbers on the program, abstracts or summaries of some of which appear below, the association elected the following officers to serve for the year 1926-27: President, J. B. Hurley, general road foreman of engines and fuel supervisor, Wabash, Decatur, Ill; first vice-president, J. D. Heyburn, master mechanic, St. Louis-San Francisco, Ft. Smith, Ark.; second vice-president, James Fahey, traveling engineer, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; third vice-president, Ralph Hammond, traveling engineer, New York, New Haven & Hartford, Providence, R. I.; fourth vice-president, A. N. Boyd, road foreman of engines, Canadian National, Turcot, Que.; and fifth vice-president, H. B. Kelly, general road foreman of engines, Pittsburgh & Lake Erie, McKees Rocks, Pa. Davis Meadows, assistant division master mechanic, Michigan Central, St. Thomas, Ont., remains as treasurer, and W. O. Thompson, general superintendent rolling stock, New York Central, Buffalo, N. Y., secretary. Two new members were elected to the executive committee as follows: D. L. Forsythe, general road

foreman of equipment, St. Louis-San Francisco, Springfield, Mo., and J. Keller, superintendent fuel department, Lehigh Valley, Bethlehem, Pa.

Address of Commissioner McManamy

In addressing the association, Commissioner Frank McManamy said that the Interstate Commerce Commission is interested in results for which the traveling engineer probably to as great an extent as any other single class of railroad employees is responsible. He referred to the previous mention of the expensive operation of the New York barge canal, stating that erroneous conclusions are almost sure to be drawn from statistics unless all conditions are known and taken into consideration in interpreting them. The canal for example has been trying to get railroads to interchange freight with it unsuccessfully and, Mr. McManamy said that the case would probably eventually go to the United States Supreme Court for final decision. He asked what railroad could be operated successfully if the roads at its most important terminals refuse to interchange freight with it.

All railroads furnish statistics to the Interstate Commerce Commission and the figures indicate remarkable results in improved operation during the past few years. Mr. McManamy quoted figures to show the improvements made, some of which are as follows: since 1916 the number of locomotives has increased 4.3 per cent, the total tractive force 27.8 per cent, the average tractive power per locomotive 22.5 per cent, the total ton miles 15.1 per cent, ton miles per mile of road 11.5 per cent, passenger miles per mile of road 1.3 per cent, revenue tons per train 23.5 per cent and revenue tons per loaded car 15.3 per cent. The traveling engineers who play an important part in securing this improved railroad operation should continue their efforts.

Mr. McManamy explained that there are twenty-eight separate acts of Congress to be enforced by the Interstate Commerce Commision, nine of which relate directly to safety. With the small force which the law provides it would be impossible to secure anything approaching enforcement of these laws without the co-operation of railroad officers. Experience over the past nineteen years indicates that at no time has the commission secured the co-operation of railroad men more fully than at present and consequently at no previous time has railroad equipment been so well maintained. McManamy then quoted statistics showing the improvements in railroad operation as regards safety, but said that further improvement can be made with the Interstate Commerce Commission working with the railroads one hundred per cent.

This does not mean the shutting of inspectors' eyes to defects, which is not co-operation in the real sense of the word.

Abstracts from Mr. Pack's address on fusion welding

The program which you have outlined has been admirably chosen to cover railroad operation, locomotive design, construction, operation, inspection and maintenance, together with needed shop facilities, all of which I am deeply interested in. I hope that what I have to say will be accepted in the same broad spirit in which it is given and as being in the interest of the designers, builders, operators and maintainers, as well as the patrons of the railroads whom we are all trying to serve in the most intelligent, satisfactory and economical manner.

I have read with deep interest your committee reports and subjects for discussion at this meeting. Especially do I want to congratulate you on the paper prepared by your committee on the subject "Locomotive availability in 100 per cent condition, up-to-date roundhouse and terminal facilities, and up-to-date methods." I am very thoroughly in sympathy with the manner in which this subject has been handled by this committee. It contains much information which, if taken advantage of, will prove of great value to all who may be interested in the safe and economical operation of the railroads.

I have had a great deal of experience with the use of autogenous or what is now more commonly termed fusion welding and the effect upon safety of its indiscriminate use in the construction and repair of locomotives and tenders. Therefore, I desire to give you the benefit of some of my knowledge of the subject based on experience and study since the inception of its general use by the railroads.

Consideration of what actually occurs during fusion welding and the results obtained therefrom, may be of assistance in enabling us to determine how far we should go in using this process. In the first place, fusion welding is simply the making of a casting between the metals being joined. The melted metal is deposited in small globules and is exposed to the air with chances of becoming oxidized or absorbing gases. It is difficult to avoid overheating or burning of the metal, and too often the weld is porous and contains slag and oxides. In the final analysis the weld is a casting, it may have all the defects of an inferior foundry casting, even when the weld appears to be of the best quality. It is coarse grained, is lacking in the desirable quality of ductility, and has comparatively little resistance to alternating stress and shock. Furthermore, no known method of inspection, other than a test to destruction, will reveal the strength or other properties of the weld.

Another feature of great importance is that internal stresses are produced in welded structures by the heat of the welding process; these stresses are largely concentrated in or near the weld but may extend for considerable distance into the parent metal.

With steel of a higher carbon content than 0.25 per cent, alloy steels and heat treated steels, such as are often used in locomotive rods and motion work, the intense heat of welding starts minute cracks which eventually result in failure. The time that elapses before failure occurs depends to a great extent upon the service stresses to which the part is subjected.

Torch cutting has an effect on the material similar to that of fusion welding. On low carbon steel the internal stresses and the transformation of the metal at the cut surface are relatively small and can be disregarded for many uses. With steels above 0.25 per cent carbon content this method of cutting should not be used unless the transformed zone which contains innumerable minute heat cracks, is removed by machining.

Much has been said and written on this subject of making good fusion welds and particular stress is usually laid on the quality of parent metal and welding wire, preparation of the material to be welded, proper welding welding equipment, and the ability, skill and integrity of the operator. However, it is my opinion that success with fusion welding consists more largely in restricting its application so that doubtful or dangerous jobs will not be attempted, rather than on the technique of the operation, though the latter is by no means of minor importance.

The question is frequently asked, "Is fusion welding permissible in locomotive firebox and boiler construction and repairs?" I am of the opinion that fusion welding, in the present state of the art, should not be used on

parts of the locomotive, boiler, or tender where through failure of such parts there is a probability of accident and injury to persons. Its use in stayed surfaces where failure would not result in personal injury and where the magnitude of the working stresses is small, and in locations where the welding is not subjected to overheating, seems to be relatively safe.

(Mr. Pack here listed a few typical failures indicating locations where fusion welding should not be used, such as boiler barrel, auxiliary steam dome, wrapper sheet seam in cab, driving wheel tires, engine truck wheels, main rods, etc.—Editor.)

Another use of fusion welding with which I am very much concerned is its application to locomotive fireboxes in the areas which may be subjected to overheating.

During the period July 1, 1915, to June 30, 1926, fusion welded seams were involved in 28 per cent of the total crown sheet failures, while 51 per cent of the total persons killed in crown sheet accidents were killed where fusion welded seams were involved. Of the riveted seams involved, 16.3 per cent failed, while 77.2 per cent of the fusion welded seams failed under exactly the same conditions. The average number of persons killed per accident in which the riveted seams were involved was .77 as compared with an average of 1.16 killed per accident where the fusion welded seams were involved.

It is a well recognized fact that serious explosions cannot occur if the rupture in the boiler is not of sufficient size to reduce suddenly the pressure. Explosions never occur with sufficient severity to throw the boiler from the frame unless the sheets tear and release the pressure suddenly. Strong firebox seams not only lessen the number of persons killed and injured per accident but effect a material saving in the destruction of property.

It may be said that a large percentage of the crown sheet failures involved in this discussion were caused by overheating due to low water, therefore, the primary causes of such failures were overheated crown sheets, and that nothing can prevent a crown sheet from coming down when allowed to become extremely overheated. I agree with this. But when a stronger construction of the firebox seams will reduce the number of fatalities and the damage to property, I feel that there can be no excuse to offer for not employing the strongest and best practical methods.

Crown sheet failures caused by low water may be likened to railroad accidents such as collisions and derailments, in which steel and wooden coaches are involved. Wooden coaches never cause fatalities unless involved in serious accidents, such as derailments and collisions. There is almost a universal demand for the substitution of wooden coaches by steel coaches because of the greater protection to the life and limb of the traveling public when serious wrecks occur. The best and safest methods should always be employed.

I do not desire to be understood as opposing fusion welding when properly and discreetly used, and believe that it has a very wide and useful field. If we are to profit by the experiences of others, we must give careful consideration to the result of all practices and methods. The extreme to which fusion welding has been carried is what I have taken exception to. It is not "a cure-all," nor can it be used indiscriminately with safety, nor even economy.

Smooth train handling

The committee on "smooth train handling" divided its subject into two parts and submitted a questionnaire to each member of the association consisting of 13 questions designed to bring out the general practice in starting and stopping passenger trains and a similar questionnaire for freight service. Answers to the questionnaires did not come from anywhere near the entire membership of the organization nor all of the Class I roads and are rather indefinite. It was brought out that the railroads are not operating their trains as nearly alike as possible or in such a way as to obtain the best results both from the standpoint of operation and maintenance. To quote from the committee report:

"While it is a conceded fact that the characteristics of roads differ considerably and that it would appear almost impossible to have more uniformity by all of the railroads, yet your committee feels that a set of rules could be worked out that could be used by all of the railroads as far as smooth train handling is concerned.

"In preparing this paper your committee has found that the subject requires a very thorough consideration of more important points as follows: maintenance, starting, speed and stopping under all conditions."

The committee then gave consideration in its report to passenger service, calling attention to the importance of maintenance, not only of the air brake equipment but of various parts of cars, particularly drawheads and couplers so that an entire train can be handled as a unit. Detailed instructions for handling trains are given in the report with due attention to double-heading, graduated release stops, two application stops, the use of retaining valves, stops for coal and water and emergency stops.

In discussing freight train handling considerable attention was given to methods of making slow-downs and stops, also brake applications on mountain grades. Regarding heavy grade braking the committee said:

"For this work the cars in the train should be specially prepared in the way of taking care of the piston travel; this should be made as uniform as possible—between 5 and 8 in. standing travel. Brake pipe leakage should not exceed 6 lb. per min. from 55 lb. or with a 15-lb. reduction from 70 lb. brake pipe pressure, and 100 lb. main reservoir pressure. On heavy grades of 1½ per cent or above the brake pipe pressure should be raised to at least 90 lb. and main reservoir pressure to 130 or 140 lb. Retaining valves should be specially prepared so that when placed in holding position and a 25-lb. brake pipe reduction is made and the brakes released with retaining valves set for holding position, at the expiration of 2½ min., the retaining valves will be turned to release position. Any retaining valves that fail to hold air and blow at the release port after the required 2½ min. should be replaced or repaired so that they will hold the required time. This is very important for grade work to prevent the overheating of wheels on some cars due to others not holding properly."

The committees also gave special consideration to the handling of long freight trains, the prevention of slid flat wheels and air brake test rack manipulation.

The report was signed by Frederick Kerby, Baltimore & Ohio, Cumberland, Md., chairman; R. I. Cunningham, Westinghouse Air Brake Company, Pittsburgh, Pa.; B. J. Feeny, Illinois Central, Chicago; James Fahey, New York, Chicago & St. Louis, Nashville, Tenn.; and A. H. Hoffman, Southern Pacific, Los Angeles, Cal.

Discussion

The discussion of this report dealt almost entirely with the use of the brakes to avoid rough handling. There was some disagreement as to whether the best method of stopping is to keep the slack stretched at all times, but as far as it could be determined from the discussion, the consensus of opinion is in favor of this practice in freight trains, keeping the throttle partially open and the driver

brakes off. Several variations of this method were described, particularly in slowing down where stops are not required except to avoid excessive rough handling of the train. The use of the open throttle was questioned by one member because of the apparent waste of fuel this practice implies. The opinion was expressed by others, however, that the saving of time resulting from the more rapid application of the brakes possible when the slack is kept stretched by the open throttle and release driver brake method, as compared with the practice of closing the throttle, allowing a gradual run-in of the slack and then applying the brakes, more than offset any loss of fuel caused by the partially opened throttle during the period required by the stop.

Most of the members who discussed the report stated that their railroads were using the graduated release feature of LN and UC equipments where passenger trains are equipped with these brakes and the value of graduated release as a means of preventing rough handling was strongly endorsed. One case was cited where, on a three per cent grade, the brakes were applied continuously for 29½ min., with a 90-lb. brake pipe pressure, and at the bottom of the grade the brake pipe pressure was still 70 lb. The practice in this case, after starting on the down grade, is gradually to bring the brake pipe pressure down as the speed increases until a balance is established as the desired maximum speed is reached.

The importance of keeping down brake pipe leakage was emphasized by several of the members speaking, one member suggesting that a big improvement could be made by car inspectors if they would carry wrenches and tighten the unions in the brake pipe and crossover pipe. These unions, he said, would frequently be found loose enough to permit from ¼ to ½ turn, a condition which otherwise would not be discovered without the soapsuds test which it is impracticable to use except at regular repair periods. The use of a one-car test device on every car passing over the repair tracks was also advocated as a fundamental step necessary in making each car as nearly free from leakage as possible. The necessity of tight clamps to maintain good conditions when once established was also emphasized and another step toward maintaining the satisfactory freedom from leakage was also mentioned in this connection—the equipment of transportation yards with air lines.

Locomotive availability — Up-to-date terminals

In approaching the question of locomotive availability through a greater utilization of the power and considering the human element which if not given serious thought is sure to result in failure, there are several factors to consider. Among the first are custom or past practices, long established; failure of the management to educate the employees to the extent that they will heartily co-operate, and if not oppose at least be lukewarm; failure of the subordinate officers to realize the magnitude of the capital expenditure involved and the resultant interest and depreciation charges, and the savings that will accrue through greater power utilization, and resultant increased mileage and tonnage handled per locomotive per year.

Up-to-date terminal facilities needed

Now that we have an improved stoker-fired steam locomotive which compares much more favorably than formerly with the best stationary steam practice in efficiency, more thought must be given to improved terminal facilities. The efficiency of a modern steam locomotive under favorable operating conditions is already so high that we cannot anticipate any radical improvement in this direction. Does this mean that if motive power efficiency is to be further improved it must be in the direction of the Diesel engine or electric traction? Further economies of the modern steam locomotive will depend largely upon our ability to eliminate stand-by and terminal losses to which this type of power is now subjected, and reduce its non-revenue hour ratio.

Two of the strongest economic arguments in favor of electrification or the Diesel locomotive are the elimination of terminal losses; not only the loss of fuel consumed by steam locomotives during their lay-over periods, but loss on the investment incurred by locomotives standing idle at terminals. Statistics show that steam locomotives on all Class I railroads average only about one-third of the time in revenue service and that at least 20 per cent of all locomotive fuel is consumed at terminals. These investment and fuel losses can be largely eliminated by electrification or practical development of the Diesel locomotive and by improved terminal facilities.

Had the efficiency with which locomotives are handled at the terminal been improved in proportion to locomotive operating efficiency, the situation would be different, but the facts are that at a majority of terminals there has been no fundamental improvement in type of facilities or method of operation. Where enginehouses have been enlarged and are better built, turntables have been lengthened and designed to operate more rapidly, coaling stations and fire-cleaning facilities have been perfected, as well as sufficient drop pits for handling of driving wheels, engine truck and trailers. With the advent of solid cast steel frames and six-wheel tank trucks, drop pit facilities should be provided for handling them quickly. Light electric traveling cranes operating on a monorail the full length of the roundhouse circle and between all drop pits speed up the work and make available for dropping of wheels the entire group of drop pits, so it is not necessary to keep one pit clear for wheel handling. Depressed spring tracks for handling spring work not only speed up several times the application of springs and spring hangers, but greatly reduce the hazard where engines are jacked to relieve weights and where spring pullers are used. A suitable hot water wash-out plant is a necessity, as also are blower lines of ample capacity.

Direct steaming offers possibilities of saving

A new departure from the old established routine handling of locomotives at terminals and with possibilities next to advantages derived from hot water wash-out plants, is the installation of direct steam for making ready engines at terminals. Proof of the practicability of this plan of speeding up the turning of power at terminals is the recent installation of direct steaming plants at the new Grand Trunk Western locomotive terminals at Battle Creek and new Chesapeake & Ohio terminals at Russell, Ky., and installations contemplated at Chicago and other locations. Absence of smoke and gases in the roundhouse, availability of the engine for quick call, ability to take the engine on quick call and immediately move out of the house to outbound ready tracks under its own pressure, making house room available, and automatically enlarging the capacity of the roundhouse, pressure of steam on the boiler to expedite spotting for work, and use of steam from an efficiently operated stoker-fired, forced draft, slack-burning power plants as against expensive steam consumption from the house blower and new inefficient green fire just started

in the locomotive, are some of the advantages claimed during the time the engine is having steam raised to working pressure.

Engines filled with water to the gauge and brought to working pressure in one hour, including filling can, if bedded previously but not lighted, be dispatched on fifteen-minute order for the engine.

This method seems to be both a radical departure and at the same time present installations indicate a practical and economical advancement in locomotive terminal facilities.

Up-to-date methods

The third part of the subject, "Up-to-Date Methods," naturally will bring us to the shops, roundhouses and mechanical organization.

The foundation of good locomotive maintenance is correct design first, then the use of proper materials and first-class and thorough general shop repairs at intervals based on a predetermined mileage governed by the type of power and local conditions.

The ability of machine tool manufacturers to produce modern tools that speed up the heavier operations is outstanding. The use of modern millers and grinders, rod machinery, annealing furnaces for frames, rods, etc., and carbonizing furnaces, normalizing processes, gas cutting and welding torches and many other improved methods are the medium of putting into service our modern locomotives so they can economically and safely negotiate runs of 500, 1,000 and more miles now and in the future with dependability.

The requirements of the Interstate Commerce Commission Bureau of Locomotive Inspection and the Locomotive Boiler Inspection Law have proved to be a blessing to the railroads of this country. Not only do they standardize locomotive conditions, but the mechanical department officers take advantage of the monthly, quarterly and many other stated inspection periods to add to the federal requirements many additional inspections of a precautionary character of their own that tend to maintain the locomotive in a much higher state of efficiency.

Give traveling company inspectors ample authority

Traveling company inspectors with authority to tie up power for defects are a great help in maintaining power at a high standard. These men examine all foremen and company inspectors on federal rules and grade them, and soon train a very efficient force of inspectors and qualify all foremen on the requirements of the federal rules. A traveling valve expert soon trains the mechanics selected at division points to look after valve gear and valve setting on the most acceptable methods of handling this class of work and maintaining valve parts to standard. This cost is repaid many times in fuel saved and uniformity of methods.

One of the greatest aids to maintain a high degree of efficiency is for the operating officer to set his mark so high and the service so exacting, and follow up any failure to attain the standards set, that all concerned will be compelled to keep in good condition the locomotives and the various devices on them which are intended to increase their capacity and to save fuel.

The report was signed by P. O. Wood, assistant superintendent of motive power, St. Louis-San Francisco, Springfield, Mo., chairman; Robert Collett, fuel agent, St. Louis-San Francisco, St. Louis, Mo.; F. P. Roesch, Standard Stoker Company, Chicago; R. McDonald, road foreman of engines, Michigan Central, St. Thomas, Ont., and J. E. Bjorkholm, assistant superintendent of motive power, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

Discussion

In the discussion of the report on locomotive availability reference was made to the importance of automatic flue blowers as an aid to efficient steam generation, and the necessity of special attention to the front end both as regards air and steam leaks. One member pointed out that locomotives subjected to the water test showed leaky superheater units in the front end, when no report of this trouble was given by enginemen. Stress was placed on the counterbalancing of locomotives as affecting the rapid wear of parts and hence reducing locomotive availability. It was stated that all new wheels should be carefully counterbalanced at the shops when applied and not main wheels alone. The question of self-adjusting driving box wedges was brought up and one member stated that an experience with 400 engines equipped with this type of wedge on his road showed that uniform adjustments for all classes of power is impossible, but that the adjustments must depend to some extent on the class and severity of service. Another important consideration is the kind of material used for the wedges. Cast iron or steel will gall when bearing against steel, which is not the case with a brass to steel combination. Consequently on this road the brass face or floater has given the best results with self-adjusting wedges which have demonstrated their value for heavy power.

Developing railroad shop foremen*

What type of man makes the best leader?—How many railroads have trained their supervisors?

By F. H. Becherer

Superintendent car department, Central Railroad of New Jersey, Jersey City, N. J.

THERE is not a question of more vital importance in the railroad world today than that of developing foremen. In the past this has not been given that prominence which the seriousness of the situation justified. However, in recent years it has been the subject of considerable discussion, and executives are using the many available agencies at their disposal with a view of strengthening and building up this important feature of their personnel.

One of the reasons for this is that the foreman is the last connecting link between the management and its workmen and forms the keystone in the arch supporting the entire organization. Foremen act as liaison officers between workmen and higher officers, interpreting the

* From an address delivered at the International Railway General Foremen's Association convention held at Chicago, September 7 to 10, 1926.

policies of the management to the men and the men to the management. In doing this they perform what is most essential, outlining and explaining to each side the reasons of the other with a view of developing and fostering a better, broader, mutually sympathetic understanding of each other's problems. It has been demonstrated that the morale of the rank and file of employees can be and is influenced to a large degree by the thoughts and actions of their supervisors. Consequently it is of the utmost importance that they understand the various phases of their responsibilities and possess the qualifications, breadth of vision and ability to measure up the situation.

Another reason is that the revenues of the railroads in the past few years has not kept pace with their expenditures. In order to exist and operate their properties on a sound business basis, the railroads must of necessity reduce their operating expenses. This can only be accomplished by effecting various economies, through the agency of foremen, of labor saving devices, new machinery, by using their present facilities to better advantage by a re-arrangement of work and by procuring production of a better quality and quantity; to obtain increased mileage between shoppings on their locomotives and to lengthen the periods of shopping on freight and passenger equipment, securing at the same time a decrease in the number of train detentions due to equipment failures.

To a large degree the success in obtaining the desired results, is predicated in direct proportion to the ability of supervision, not however, losing sight of the fact that the skill and ability of the individual workman is of great importance. The efforts of the best workman, however, can only reach their full effectiveness when guided and co-ordinated by skilled and competent leadership.

Selecting future leaders

It has often been said that foremen are born, not made, and to a certain extent that is a fact. The man who has been studying character is enabled to pick out the natural born leaders. Inasmuch as some must be made, the time to start is when they are employed as helpers and apprentices. The employing officers should be capable of selecting from among the applicants for employment those who in his opinion possess the qualifications and attributes necessary for leadership, and call these to the attention of the officers for systematic training which will be outlined later.

The general foreman should confer with the foreman under whose direction those so selected are working; he should whenever going through the shop, talk to these men with the idea of obtaining their viewpoints on the fundamental principles. It should not take long to determine whether or not the judgment of the employing officer is correct. After the workman has served his required number of years and has demonstrated his ability, an excellent plan is to assign to him a piece of difficult work or some disagreeable task and check his reactions. A few instances like this should enable one to determine whether he possesses the required ability and stamina to be considered further. If the reaction is satisfactory when a position of leading man is vacant, the foreman in that department should be requested to make a selection of two or three whom he desires to be given consideration. The workman so selected should be called before the foreman and general foreman and pass an oral examination to demonstrate his knowledge not only of the particular work to which he will be assigned, but with a view of determining his ability to grasp the human relation problems and his ability to handle men. After the appointment to leading man has been made he should be advised and assisted. Whenever he makes a mistake it should be explained to him and he should be shown how it could have been avoided. Whenever possible, he should be asked for an opinion on various subjects; in other words, a little deference should be shown him while he is a foreman in embryo, as it is essentially important that he be prepared to fill the higher position when vacant. At times when the foreman is absent, naturally he will fill the position. On these occasions he should be under observation to determine his capabilities for further advancement.

It is my opinion that the finest basic training a man can obtain is through an apprenticeship system. The road which has already instituted apprenticeship training for its mechanics possesses a valuable asset in that it can procure from among these graduates, men who are naturally endowed with the necessary qualifications for leadership. Some roads select these men, also men of mechanical ability from among mechanics and leading men in car and locomotive departments, and promote them to special apprentices, giving them the benefit of a year or two of intensive training, after which they are assigned to special duty. Experience has demonstrated the fact that they are particularly desirable as supervisors due to the training they have received.

In the selection of men for supervisory positions the opinion of the man to whom they are to report should play an important part in the selection, and appointments should never be made without that officer's full consent, as nothing will disorganize the supervisory force quicker than to show favoritism and promote a man without the knowledge or consent of his immediate superior,—in shop parlance, "going over his head." We look to foremen for results and we should not tie their hands by assigning to them, particularly in minor supervisory capacity, men whom they do not believe competent.

Staff officers should from time to time call the attention of the proper officers to those workmen who, in their opinion, are capable of receiving promotion. Many a man so selected has proved to be a veritable find, and when promoted has demonstrated his ability to fill the position to the utmost satisfaction. On some roads staff officers are instructed to report to the mechanical superintendent when they discover men of exceptional ability, filling minor positions, in out-of-the-way points, where in the natural course of events they would not come to the attention of the appointing officer.

The essentials of a foreman

Essential qualifications which the prospective foreman should possess to be successful are tact, self-control, fairness, persistence, industry, loyalty, honesty, initiative, and good judgment of human nature. He should have a fair education; at least that of a public school and, preferably, a high school. If a college graduate his advancement will be more rapid. Obviously, he must thoroughly understand the work, and if necessary, possess the ability to show the new workman how to accomplish it with least physical effort and at the same time secure better quality and quantity.

Tact or diplomacy is that delicate skill in saying or doing what is expedient in the many situations that arise. Properly used, it acts as an oil on troubled waters. Self-control is an absolute necessity, it can be cultivated to a certain degree, but the foreman who can not control his anger soon loses the respect of his workmen. The supervisor who is fair and just rarely encounters embarrassing situations, he never decides until he has heard

both sides of the case, never uses snap judgment, does not show partiality or favoritism, and when he makes a promise, always keeps it. Persistence is that "stick-to-it-ive-ness" spirit, from the vocabulary of the possessor of which the word "cannot" has been eliminated, and the phrase "will try" substituted. He goes slow, is sure he is right, and usually wins his point.

A drone will never be a leader but the man who is industrious cannot help but gain and maintain the respect of all who are associated with him. Loyalty is one of the prerequisite traits. The supervisor who supports his superior officer and is loyal to the company which employed him must succeed. Some faults can be overlooked but disloyalty to my mind is one of the cardinal sins and cannot ever be condoned. Honesty is that pearl of virtues. It does not permit of "buck passing." When asked a question the foreman always answers it truthfully, even though he sometimes places responsibility upon himself. Initiative is that attribute which enables a man when placed in difficult places to study the problems and plan how to surmount the obstacles.

Now we come to that qualification which is an absolute necessity—ability to judge human nature and understand the problem of human relations. The day is past when a man's ability as a foreman was measured by his capacity to drive men, one whose every sentence was interspersed and punctuated with profanity. Eliminating the use of profanity by foremen marked the dawn of a new era as the supervisors of today when issuing verbal instructions, or giving orders, do so in a manner which leaves no room for doubt that they are to be obeyed. However, these orders are given in language which commands the respect of employees to whom they are given.

What some roads have done in training foremen

Methods used in the training and development of foremen have undergone a decided change during the past few years. The old system of promoting a man, then leaving him to his own resources to work out his problems has been abolished. Those selected are now given systematic training from the time they enter the service. Practically every road has instituted some form of developing foremen. Many of the larger roads, realizing the importance of this phase of the work have authorized certain expenditures so that the instructions can be carried on systematically. Several eastern roads, among them, the New York Central, New York, New Haven & Hartford, Delaware, Lackawanna & Western and Boston & Maine, have appointed men in charge of personnel. Part of their duties is to co-ordinate the educational work on their properties and under their direction this intensive training is given, not only to prospective supervisors but to those already filling these positions.

Several methods are used; some roads utilizing all and others only a portion. In the main, however, they may all be grouped under four major headings; the lecture, text pamphlet study, conference, and university extension methods.

Under the lecture may be classed foremen educational clubs, and staff meetings. The practice usually followed in foreman's clubs is to select for the topic some subject which is a very live one due to the fact that it has been the cause of detentions to trains en route on account of locomotive or car failure or the men, sometimes the mechanical officer in charge, has felt the necessity for increased knowledge on the part of the foreman on that particular subject. A paper is prepared by one of the staff officers or general foreman who has previously been selected on account of his expert knowledge of the subject. After the presentation of the paper the subject is opened for general discussion. The establishing of this open forum, and the sometimes heated discussions which ensue only tend to make them the more interesting. These meetings provide a common ground upon which everyone is invited to express his opinion, to present for discussion certain information, or request a correct solution of problems pertinent to the subject which had arisen in his daily work. The discussions which ensue have proved to be of inestimable value to the supervisors and to the railroads.

Staff meetings are a positive necessity. The railroad officer who does not hold them is not giving his subordinates the proper instruction. It is at these monthly, weekly, or daily meetings that he should impart to his staff the information which he wishes placed before his foremen and they in turn to the rank and file. On these occasions questions of policy are brought up for discussion and the information obtained from the staff is of the utmost value not only to those present but also to the management. The range of subjects discussed is extremely valuable in the development of foremen, giving them an insight into the proper use to be made of records, instructing them how to analyze and compare statements, how they are used for comparative purposes and the influence which they exert on future policies.

The text pamphlet method of developing foremen is widely used by a great many railroads. Pamphlets or booklets are prepared by the various staff officers, and sent out to the foremen covering subjects over which they have supervision. In some cases these pamphlets are also given to prospective supervisors, and in a few instances to the men. After a sufficient time has elapsed to enable those to whom they are given to have thoroughly studied them, a series of questions is given, sometimes written and sometimes oral, with the idea of determining how much of the subject has been absorbed. This method is also supplemented by various educational bureaus which prepare these pamphlets and sell them to all of the employees, regardless of their position, and are a valuable asset in the developing not only of foremen but of the rank and file. Some roads in order to encourage this effort on the part of their employees cooperate to some extent with these bureaus, and permit their employees to pay for these courses by having a certain amount deducted from their pay. In some cases, of course, the employee's intentions are excellent at the start, but due to lack of effort, and industry, they are not completed. The men in these cases are certainly undesirable as supervisors.

Another one of the practices instituted on numerous roads is the daily shop meeting or conference. This is attended by foremen of all departments, the local storekeeper or his representative. They are usually held in the morning around nine o'clock consuming from 10 to 30 minutes. Subjects brought up for discussion are material, schedules, production, safety, changes in policy, locating and eliminating delays, planning for daily production. These meetings are of immense value to the foreman as they inculcate in him the spirit of team work and co-operation.

Outside influences valuable

The vast majority of roads send their staff officers and foremen to the various conventions, one of which is the International Railway General Foremen's Association convention.

I cannot lay too much stress on the opportunity within the reach of every supervisor and prospective super-

visor, and that is his ability to procure such technical magazines as Railway Age, *Railway Mechanical Engineer*, Railway Journal and Railway and Locomotive Engineering. The importance of these publications has long been recognized by the railroad managers who have subscribed to them in large numbers, to be sent to their various officers. These publications are always available to those who indicate a desire for self-improvement. The articles appearing in them are of valuable assistance to the man looking for improvement and advancement. Not long ago I was intensely interested in a discussion appearing on one of them as to the benefits derived from reading the advertisements. At this time I want to state that the man who does not read them is not keeping up with the times.

A few weeks ago one of the departmental superintendents wrote a letter to his staff calling attention to an article appearing in one of these magazines, asking for comment. The replies received showed that his men had noticed and read it and from the wide diversity of opinions obtained, indicated that they were not the so called "yes, yes," or rubber stamp variety.

Permitting your supervisors to visit other shops on your own road and shops on neighboring roads is of valuable assistance. A few years ago a committee of three on an unmentioned road were appointed to procure information relative to installing a piece work system. They spent ten days covering several different shops on various roads. The good points of all the systems were incorporated in their own. Should you ask the mechanical superintendent of that road if the information obtained was commensurate with the expense involved he would tell you that they were still paying dividends on the original investment.

Colleges recognize the importance of the work

Within the past few years a new avenue of instruction has been opened up to the foremen. State universities of several states with aid of the Y. M. C. A. have organized classes;—in some cases of foremen and in others of mechanics. Notable examples are the University of New Hampshire, University of Michigan, Rutgers University, Massachusetts Institute of Technology, Pennsylvania State College, Iowa State College and others.

Quoting R. V. Wright, editor of the *Railway Mechanical Engineer:* "They must be conducted under strong and efficient local direction and have properly equipped leaders," and I would add, the earnest desire of the individual for self-equipment.

In recent years we have often heard the expression that the opportunities for advancement on railroads do not exist as they formerly did. It is my opinion that the opportunity within the reach of every individual railroad worker far surpasses the opportunities or avenues for education which were open to railroad men of the last decade. University extension work is yet in its infancy or experimental stage. It will continue to grow and I believe that within the next few years we will see a well defined college course for foremen, outlining the subjects which the railroad men of today find so necessary.

Co-operation with other departments necessary

One phase which has seriously interfered with the development of the foreman has been the lack of instruction regarding the relation of his own to other departments. Much stress is now being laid on this phase of the situation, and it is particularly noticeable in the suggestions given before railroad foremen's clubs. In one of the editorials appearing in the *Railway Mechanical Engineer* the question is asked " 'Why is it that more car men do not succeed in reaching the higher executive positions.' If there is one reason more than another it is because they become too engrossed in the details of their own special work to see how best to co-ordinate their efforts with those of other departments, how best to develop the breadth of view which is absolutely essential to the successful railroad executive officer."

We believe that there is just as much available timber in the car and locomotive departments as there is in the operating department. The essential thing is an opportunity for the broad visioned, hard thinking man of these departments, and there is no question but what he will succeed.

A successful foreman must understand his men

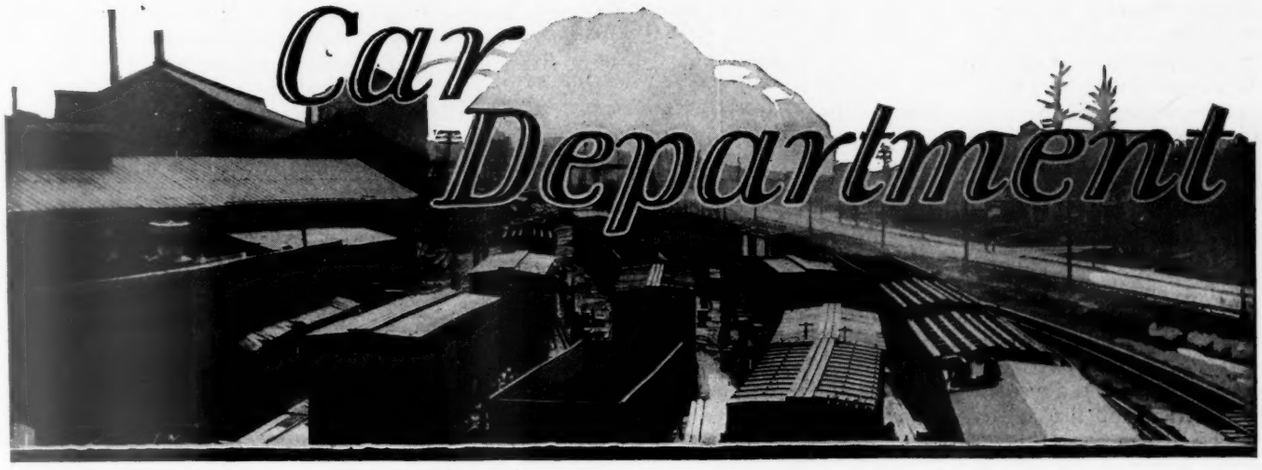
The foreman has under his immediate supervision the three M's, material, machines and men. Of these the most important is men. Regardless of what excellent facilities a shop may possess, as to modern buildings, equipment and machinery, if a foreman does not thoroughly understand the men placed under his care, he can never hope to obtain that degree of success for which we are all striving. It does not entail any expense or unusual effort to become interested in the things which are close to the hearts of his men. There is nothing which will gain the universal admiration and respect of all his men more rapidly than to show an interest in that which is most dear to them, and that is, their family. When sickness, death, or trouble enters a home, a word of inquiry or consolation with such aid or advice as can be given, goes a long way towards demonstrating to his men that he is not only interested in them for the work which they perform but in their personal welfare. It is surprising what large dividends are paid by efforts so expended.

Previously I have stated that I would give you some of the results obtained on various railroads from foreman's training. On one road a large portion of the credit is due to the intensive training given their foremen, which has resulted in an increase of 100 per cent in the mileage of locomotives between shopping. It has resulted in an increase of 600 per cent in production in individual cases. On the same road it has resulted in a decrease in locomotive failures from 1,900 per month in the year 1923, to 140 per month in 1926. On another road there has been a marked decrease in the detentions to trains en route due to locomotive and car equipment failures.

It would be possible to elaborate on this to a great extent but I believe these few instances will tend to demonstrate to you the results obtained from the extensive training given their foremen.

Comparison of 10-coupled locomotive types—A correction

ATTENTION has been called to an error in the table of examples of recent locomotives of the 2-10-0, 2-10-2 and 2-10-4 types published on page 481 of the August *Railway Mechanical Engineer*. The Texas & Pacific 2-10-4 type should have been shown as a limited cut-off locomotive; the coal rate, lb. per sq. ft. grate per hour (Cole) and the steam rate required per hour, lb (Cole), which are based on full stroke cut-off, should have been disregarded as was done in the case of the Pennsylvania limited cut-off 2-10-0 type locomotive.



Car inspectors' association changes its name

Silver anniversary of first convention notable for broad treatment of important car problems

ON the twenty-fifth anniversary of its founding the Chief Interchange Car Inspectors' and Car Foremen's Association of America convened at the Hotel Sherman, Chicago, September 21, 22 and 23, and exhibited a firm determination to capitalize on the inspiring history of the association as an incentive to still greater achievements. The convention was notable for the earnest discussion and broad treatment given to important car problems, particularly as relates to the efficiency of the railroads as a whole, and at the closing session it was decided that the association can best serve its purpose and increase the scope of its work by changing its name so as to encourage and promote membership by car department supervisory officers of all ranks. It was accordingly voted that the Chief Interchange Car Inspectors' & Car Foremen's Association of America be hereafter known as the Railway Car Department Officers' Association.

The total membership of the Railway Car Department Officers' Association is now in excess of 1,300, about 400 memebers being in attendance at the Chicago convention. Following the usual opening exercises, an inspiring address was made by R. H. Aishton, president of the American Railway Association, who eulogized the work of the association and closed with the following comments on its future possibilities:

"In summing up, I might say, that the proper carrying on of all of your work as it ought to be carried on has a tremendous effect in many ways. It means less loss of life and limb of trainmen, greater car mileage, fewer accidents, less destruction of property and equipment, less repeated shopping of equipment, greater available car supply at all times, less need for the purchase of new equipment, decreased cost of operation and maintenance, more prompt handling of business resulting in greater satisfaction to shippers and better earnings for the railroads. What better goal could you work to than this?"

The association was addressed by President W. P. Elliott, general foreman, Terminal Railroad of St. Louis, and then Joe Marshall, special representative of the American Railway Association, discussed the progress of work in freight claim prevention. The subject of handling explosives and other dangerous articles was presented by E. J. League, representing Col. B. W. Dunn, chief inspector of the Bureau of Explosives. Individual papers were presented as follows: Handling Wheels and Axles at Wheel Shops by W. P. Westall, assistant district master car builder, New York Central, Toledo, Ohio; the Trouble of the Small Interchange Points by John Rauscher, chief interchange inspector, Cincinnati, Ohio; Preparation of A. R. A. Billing Repair Cards and Record of Repairs Simultaneously at the Car by C. C. Hennessey, chief A. R. A. clerk, Cleveland, Cincinnati, Chicago & St. Louis; Progressive Rebuilding of House Cars by C. M. Hitch, district master carbuilder, Baltimore & Ohio, Cincinnati, Ohio; and Reduction of Transfers at Large Terminals by C. J. Nelson, chief interchange inspector, Chicago. The usual animated discussion of A. R. A. Rules of Interchange and interpretations of the Question Box committee, were participated in by many of the members in attendance.

Election of officers

The following officers were elected for 1927: President, B. F. Jamison, special traveling auditor, Southern, Meridian, Miss.; first vice-president, E. R. Campbell, chief interchange inspector, Minnesota Transfer, St. Paul, Minn.; second vice-president, M. E. Fitzgerald, general car inspector, Chicago & Eastern Illinois, Danville, Ill.; third vice-president, W. R. McMunn, general car inspector, New York Central, New York City; A. S. Sternberg, master car-builder of the Belt Railroad of Chicago was re-elected secretary-treasurer.

Four new members were elected to the Executive Committee: C. J. Nelson, chief interchange inspector, Chicago; M. P. Cole, general car inspector, Boston &

Maine, Boston, Mass.; E. D. Colon, shop efficiency engineer, Pere Marquette, Detroit, Mich.; and H. J. Smith, general car inspector, Delaware, Lackawanna & Western, Scranton, Pa.

One feature of the convention greatly appreciated by the membership was the moving picture shown in connection with Mr. Westall's paper on wheel shop work. This moving picture, taken by W. H. Miner, Inc., Chicago, and shown through the courtesy of that company, aided materially in visualizing the principal points brought out in the paper.

Another feature of the convention was the inspirational talk by F. W. Brazier, assistant to the general superintendent of rolling stock of the New York Central, at New York, who has taken a kindly and helpful interest in the association almost since its founding.

Abstracts of the addresses, papers and reports presented at the convention will appear in this and subsequent issues of the *Railway Mechanical Engineer*.

President Elliott's address

Some system must be devised that will eliminate, if possible, the unnecessary transferring of cars, and I recommend that this subject be thoroughly discussed by the association in order that we may go on record with suggestions that will be acceptable to the arbitration committee.

A number of railroads have associated themselves together with the understanding, that if a car with a transferrable defect is safe for movement or can be made so with temporary repairs, it may be allowed to proceed to its connecting carrier, transfer authority being issued by the original delivering line should subsequent transfer prove unavoidable. A large number of cars have been handled under this agreement, demonstrating that it has been beneficial not only to the railroads but to the public and shippers as well. If all cars were of foreign construction and equal to the ordinary handling in classification yards and heavy train movement, such arrangement possibly would not be necessary. It is unfortunate, however, that due principally to the various types of equipment construction, many of them weak in design, with the handling line not able to make repairs for the want of parts, transfers must be made.

Visits to many large terminals and exhaustive inquiries indicate that the majority of the railroads at these large terminal points are not properly equipped with facilities to make necessary repairs to cars either under load or empty. This is one important cause for the continuous transfer of equipment.

It is the hope that through the work of the Arbitration and Price committees, after giving due consideration to the present situation, prices for labor and material will be made adequate in order to encourage the handling lines to maintain foreign equipment. Under the present status, the tendency of the handling line is at all times to move the car homeward over some other connecting carrier.

Equipment should be inspected prior to being loaded, particularly, at industries on these various lines. It has been my observation that at large terminals, inspection is made more thoroughly than at outlying points where possibly no inspectors are engaged, thus contributing to delay of cars en route, either on account of repairs or transfer.

Today we are giving closer attention to air brakes than ever, which is contributing largely to the splendid car mileage per day being made. I sometimes wonder if we are giving similar attention to the hand brake. Our one source of trouble in the past has been worn brake hangers, brake hanger pins, etc. It is my opinion that these conditions are more due to vibration than actual wear from brake operations or carrying the brake beams. Most modern cars are equipped with modern devices which steady the brake beam and reduce this vibration to a minimum. Our forces should be trained to maintain these devices in their higher state of efficiency.

Brakes properly maintained protect train movement. Friction draft gears properly maintained protect switch movement at terminals. We have set periods for inspection and repairs to brakes, journal boxes, etc., which is the reason that we obtain safe and efficient operation. It is my belief that we can set up similar rules for the inspection and repair of draft gears to insure their safe and efficient operation and a minimum damage to equipment and commodities in switching service.

Friction means wear and it is no more reasonable to expect friction draft gears to go on indefinitely without wear than to expect air brakes to function without wearing the brake shoes. I would suggest that this important subject be handled by a committee to make recommendations at the proper time.

In my opinion much good will result if a local association of our membership will function at each large interchange center. Our membership, being composed exclusively of supervisory car department officers, would enjoy every confidence of the railroads at these centers, and local conditions could be discussed at meetings held several times during the year, matters of national importance being brought to the attention of the annual convention. I believe this will work much to the advantage of the association and would place in all large terminals a body of men on whom the Arbitration committee could call for advice regarding local conditions.

Resolutions offered by C. J. Nelson

The question of rebuttal transfer, or agreement by one road to move cars with transferable defects not militating against safe operation, provided it is guaranteed against loss should subsequent transfer prove unavoidable, was in dispute among the members of the association. The set of resolutions, however, offered by C. J. Nelson, chief interchange inspector, Chicago, as the solution to the whole transfer problem met with practically the unanimous approval of the association. These resolutions are as follows:

1—That selfish interest be avoided to the best advantage of the railroads as a whole, and their patrons, with the predominating policy of united efforts to forward all loaded cars to destination without transfer.

2—That the maximum efforts be made to maintain freight cars in sufficiently good condition to carry their loads to destination.

3—That efficient and systematic inspection of cars be required to prevent the loading of defective cars which may have to be repaired, or may require transfer of loads before reaching destination.

4—That every practical effort be made to have cars repaired underload, but in the event repairs cannot be made underload, permit cars to go forward, provided, of course, they are safe to handle in road trains.

5—That loaded cars found with defects that render them unfit to carry loads to destination should not be offered in interchange, but should be repaired or transferred by the handling road with the understanding, however, that when once delivered they should not be returned.

6—That if a defective car is safe to carry its load to destination, the fact that it might be transferred before reaching destination on account of conflicting opinions, that it might be necessary to place it on the repair track after it has been unloaded at destination and perhaps wait for material from the owner, or that it might be necessary to return it home empty, should not be taken into consideration in deciding whether or not the load should be transferred.

7—That in the event it becomes necessary to repair a car, or transfer its load before it reaches destination due to defects that apparently existed when the loaded car was previously received in interchange, utmost care should be exercised in deciding whether or not the judgment of the men who allowed the car to go forward was at fault, in order to avoid unfair criticism which invariably has the detrimental effect of causing men to become unduly technical.

Loss and damage

By Joe. Marshall

Special representative, American Railway Association

Using round figures, last year the loss and damage bill of all railroads was 36 million for the United States and two million for Canada, or 38 millions. About 88 million dollars have been taken off the loss and damage bill during the past five years, and with this money you could pin a twenty dollar bill on every man, woman and child in Cook County, Illinois, and have a lot of money left.

The work on the loss end of the loss and damage bill has advanced to the point where the principal attention is now being paid to damage, with particular reference to carload freight. If we include delay, this item will represent 63.3 per cent of the total paid.

There are about 130,000 car men in service and they wield an important influence in the work of handling freight safely.

The car repair bill for the United States in 1924 was $380,925,734 or 8.4 per cent of the total railroad expense. In Canada it was $28,298,158 or 7.5 per cent. The loss and damage in that year was $41,262,583 or .8 per cent of the total expense for the United States and $2,254,812 or .6 per cent for Canada. I am giving you these 1924 figures in order that a comparison may be made since 1925 car repair figures are not as yet available.

It has been estimated, from reliable studies, that about 3 per cent of the car repairs can be charged to rough handling of equipment in trains and yards. If this estimate is fair we thus can add 11 million dollars to the United States claim account and 850 thousand dollars to the Canadian account, and in that manner provide a larger field for results in reducing this expense.

You are interested in defective equipment. The highest sum paid on this account in any one month was $1,050,268 in April, 1921. The lowest sum was $263,390 in November, 1925, and that was 29 thousand less than the average paid per month in the year 1914 when we were doing less than half the business we are doing today.

Here are the principal items in 1925:

	Commodity	Carload	Less Carload	C.L. & L.C.L. Total
9	Grain	$1,313,860	$5,495	$1,319,355
24	Coal and Coke	751,938	5,959	757,891
10	Flour and Mill Products	341,953	12,695	354,648
35	Miscellaneous Commodities	336,912	26,826	363,738
5	Fresh Fruits and Vegetables	162,940	3,418	166,358
11	Sugar	148,554	3,075	151,629
25	Lumber and Forest Products	76,342	1,564	77,906
23	Cement, Lime and Plaster	69,077	1,823	70,900
20	Iron and Steel Products	38,966	2,578	41,544
6	Live Stock	36,075	151	36,226
12	Groceries	25,024	3,706	28,730
	Total	$3,301,641	$67,290	$3,368,925
	Total of all commodities	3,462,939	106,255	3,569,194
		$161,298	$38,965	$200,269

$3,569,194 was paid on defective equipment in 1925; this is 9.2 per cent of the total and it divides as follows:

Grain, carload	36.8 per cent
Coal and coke, carload	21.0 per cent
Flour, carload	9.6 per cent
F. Fruits and Veg., carload	4.6 per cent
Sugar, carload	4.2 per cent
Less-than-carload freight	3.0 per cent

Defective equipment is a matter of selection of the car best suited to the commodity it is to carry, and with comparatively few exceptions you will have no difficulty in any yard in finding the few good cars required for the comparatively few high-grade commodities, highly susceptible to damage when an improper car is used. Using high spots I find these high-grade cars would number approximately four million and eight million for low-grade, meaning coal, out of 51 million cars loaded last year. At a pinch, consider four million for the high-grade or 8 per cent. If we play on this 8 per cent we can reach 55 per cent of what is paid on defective equipment and if we add the coal cars we can get another 21 per cent.

Classified commodity card system helps

It has been shown that we can always find sufficient cars to serve our high-class commodities, especially when a good classified commodity card system is in effect. One road has found this true in large terminals, they have a man assigned to this work who applies cards to cars loaded by local as well as foreign line industries.

Your help in the rough handling campaign can come through the means of using the facts you develop in the car department when repairing cars. For example, one road reports 16 couplers removed from certain cars. Here is what they found:

3 shortened 1 in.
2 shortened ⅞ of an in.
3 shortened ¾ of an in.
4 shortened ½ in.

all the balance shortened anywhere from ¼ to ½ in. and all of them shortened, or upset cold, by impact. This is good stuff to present to those who handle cars; it is unanswerable proof.

In another case, check of coupler failures showed:

Inherent defects	50 per cent
Rough handling	30 per cent
Train parting	20 per cent

In another case, a check of bad order transfer showed this:

Old defects	60 per cent
Failures to note defects when loaded	10 per cent
Rough handling	20 per cent
Accidents	10 per cent

Another check of a number of cars transferred showed this:

Sills split and broken	40 per cent
Bolsters broken	29 per cent
Truck side and frame	19 per cent
Draft arm and channels	12 per cent

These are the examples or the proof the car department can present to local meetings of railroad men in order to sell the idea that these things result from handling and to the degree that we can ease our handling, to that degree we will save expense, labor and trouble to all the departments that must clean up the bad effects produced by mishandling, or waste of any nature or description.

Today delay payments result from individual cars getting into trouble and not to slow movement of train. A test for two weeks made at two terminals shows 500 cars cut out of trains on account of bad order; this not only delays the car, but delays the trains, so the subject is of double importance. Don't cut cars out of trains on account of bad order if there is any way to avoid it. Repair them in the train if possible. If a car is cut out, special efforts should be made to see that trains are not run around it.

Suggestion in connection with blue flag rule

We have another example here of OPPOSING FORCES that sometimes apply in connection with delay. Take the blue flag rule for example. Of course

no one wants to unload the blue flag rule, but we have trains twice as long as we had when this rule went into effect, so we ought not to have a yard crew waiting if we can find a way to shift the flag and give them part of the train to work on while the car man is working on the balance. In order that you may have something in your proceedings to show the high spots in delay, the big end of which is fresh fruits and vegetables, I will quote some high spots developed in an analysis of 1926 fresh fruit and vegetable claims amounting to 162 thousand dollars, by a committee of the Eastern Claim Conference:

Engine failure	12.4 per cent
Passenger train interference	9.0 per cent
Wreck	1.3 per cent
Defective equipment	7.9 per cent
Icing and classification	9.3 per cent
Congestion	30.0 per cent
Diversion orders mishandled	.7 per cent
Improper notification	1.1 per cent
Miscellaneous	28.3 per cent

By departments this divides as follows, for the road 60.6 per cent, for the yards 18.8 per cent, for the terminals 20.6 per cent.

We still have cases where cars are loaded and must go on the rip track for defects even before they can get out of town, which means a 24-hour delay. Any car under load which can be repaired in yard or in train without placement on rip track will help greatly in the delay account, also it is an easy thing for a car to become two or three days old after it misses the first sitting or repair track and then more delay may follow in digging it out. We think much of our delay money now goes to the car which gets into trouble and further reduction will depend upon the extent to which this feature can be supervised.

By the very nature of his work the car man is a natural prevention man, he is a builder, and as a builder he is opposed to waste of any kind, and he is the strongest force in this respect the claim and claim prevention man can find in any branch of the railroad service.

Operation of wheel and axle shop

By W. T. Westall

Assistant district master car builder, New York Central, Toledo, Ohio

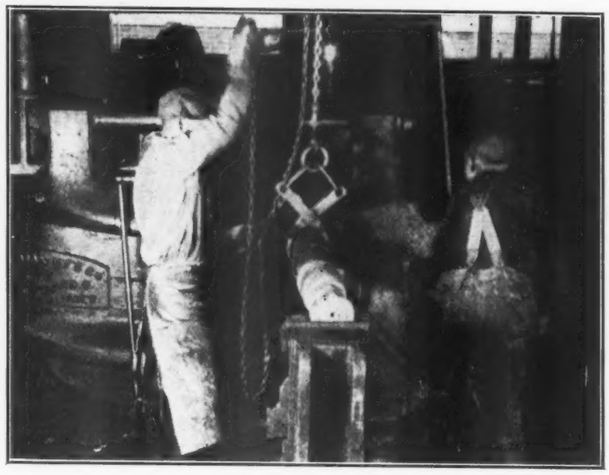
Cars with incoming scrap wheels and cut journals for demounting and truing, are placed on an industrial track, within reach of an overhead traveling air hoist which spans four tracks. A double rail scrap storage track and two double rail storage tracks for serviceable mounted wheels are provided.

The two double rail storages for serviceable mounted wheels are 271 ft. long, and will hold 160 pairs each, the rails being so spaced that journals cannot be damaged. These tracks are elevated at the cross industrial track, and slope toward the air hoist where loading is done, so that the wheels move down by their own weight. The double rail scrap storage is elevated below the air hoist so that the wheels move toward the wheel shop in the same way.

As the wheels are unloaded by the stores department the same cars are reloaded with new or second-hand serviceable wheels. Eight cars can be handled without further engine switching, by means of a block and pulley secured in a concrete foundation with a chain to an air hoist piston and the car truck.

Each wheel and axle is marked as it is removed from a car showing the date and defect by code numerals stenciled on the back of the flange as follows: *0*-worn tread; *1*—shelled out; *2*—brake burn; *3*—seamy tread; *4*—worn flange; *5*—worn through chill; *6*—slid flat; *7*—broken hub from pressure; *8*—chipped flange; *9*—chipped rim; *10*—cracked plate; *11*—cracked bracket; *12*—seamy journal, *1-28*—cut journal *2-28*—bent axle; *3-28*—long journal; *4-28*—loose wheel; *28*—OK for remounting. As these wheels are received at the wheel shop for dismounting, a report showing the list of defects is forwarded to the wheel shop foreman.

The shop wheel inspector checks all wheels and axle



Worn axles are set in Ajax forging machine in four operations: First and second, squeeze dust guard seat; third and fourth, form new collar

defects with these records and in this manner any defect that might be overlooked by the points forwarding the wheels or any changes to be made are corrected, and the originals returned to the shipping point for correction of the records. Wheels that have failed to make the guarantee, wheels for test, broken-off journals and all defects which may have caused derailments and delays

A special two-wheel truck facilitates handling axles

are then stenciled "HOLD FOR FINAL DISPOSITION."

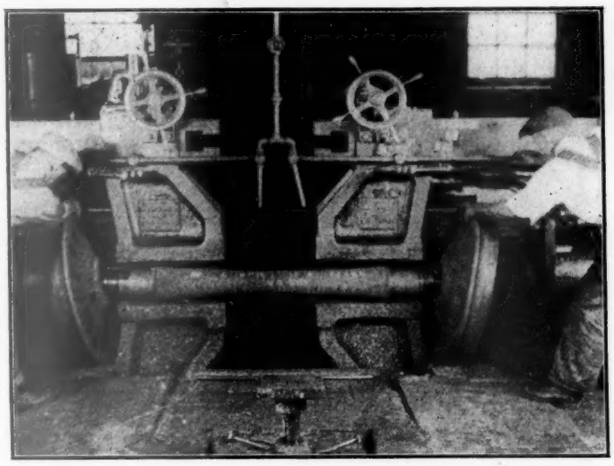
All axles for turning, and the scrap axles for upsetting are delivered to storage piles in front of lathes by one press man by means of an air hoist and overhead trolley.

Scrap axles not suitable for upsetting are taken out of the shop by laborers, chipped by them and marked steel or iron by the foreman. Axles are then loaded on

an axle scrap car placed at the end of the wheel shop on depressed track, and disposed of as sales orders are received. Scrap axles for upsetting are handled through the lathes as they come off the press, and on the 5-in. by 9-in. size, collars are turned off and journals turned down to 4 13/16 in., this being the largest size that can be handled on this forging machine, hence the necessity for turning off the collars.

Method of reclaiming axles

On axles with 5½-in. by 10-in. journals, the collars only are turned off and the axles shipped to other points



Two wheels are removed at a time in the 400-ton Niles double-acting car wheel press

having larger forging machines to be upset to 5-in. by 9-in. size or 80,000 lb. capacity. After turning, the axles are taken to storage piles between the wheel shop and blacksmith shop for upsetting in the forging machine. The axles are placed in a furnace, the ends being heated to the proper temperature for upsetting. This work requires three to four operations per end, according to the worn condition of the journal or dust guard seats.

The first and second operation is the squeezing of the dust guard seat to decrease the diameter and increase the length. The third and fourth operation is the forming of the collar obtained by the increased length brought about by stretching.

The average output is about 60 ends or 30 complete axles per 8-hour day. Axles are then transported to the annealing furnace by means of an electric truck and trailer, unloaded on an elevated platform for loading on axle car which in turn is placed in the furnace.

Forty-two axles are placed in this furnace, spaced 3 in. apart on the car to allow for proper heating, which is between 1425 to 1475 deg. F., the heat being controlled by a Tycos pyrometer. The axles are held at this temperature for 6 hours, the furnace then being shut off and axles left to *cool in the furnace*. After cooling, the car is taken out to the elevated platform and axles rolled direct into storage piles.

Before going to the furnace for annealing, upsets are checked at the forging machine by an operator and foreman for the proper length over all, and the distance between dust guards, collar and journal diameter with gages designed for that purpose.

Axles for machining are taken from the storage piles inside the shop by means of air hoists and overhead trolleys, which are so arranged as to lift the axle to the proper height, and carry it central into the lathes. The size of the wheel seat diameters is stencilled back of the wheel seat with 1½-in. figures with white lead, and the operator's mark is stamped with a steel letter on collar of all axles turned.

The press output averages 90 pairs of wheels pressed on in 8 hours, or approximately 11½ pairs per hour and approximately 26 pairs pressed off; this includes oiling, changing of press, and removing axles that are fitted up from storage piles so that boring mill operators are not handicapped in their fitting.

Machine equipment in wheel shops

The machine equipment includes one double-end Niles car wheel press of 400 tons capacity, and 13-in. ram. On one double-end No. 3 Niles axle lathe, the average production in 8 hours is 20 second-hand axles, or 11 new, or 8 upsets turned complete, or forty 5-in. by 9-in scrap axles turned for upsetting. One double-end heavy-duty Putnam axle lathe of about the same average as the Niles is provided.

One single-end Bridgeford journal turning lathe is used for axle turning only, with a 10-in. way extension added. The output of this machine is 16 second-hand axles or 8 new axles finished in 8 hours or 32 scrap 5½-in. by 10-in. (collars turned off for upsetting).

One journal lathe (New York Central make) has an average output of 11 pairs of cut journals in 8 hrs.

One Putnam 48-in. car wheel borer, equipped with special Davis two-in-one boring bars, has an average output of 66 wheels in 8 hrs.

One Niles 48-in. car wheel borer has an average output of 68 cast wheels in 8 hrs.

The wheel shop organization consists of one foreman, one night gang leader having supervision over the night force in the blacksmith shop and fabricating shop, two wheel pressmen, two boring mill operators, four axle lathe operators, one journal grinder operator, three laborers.

Our machine operator force is familiar with either

New York Central wheel shop at Toledo, Ohio—Note inclined rails to shop—Depressed track beside shop facilitates loading and unloading wheels

lathe, boring mill or press work, so that when men are absent their places can be easily filled. Axle lathe and boring mill work is checked by the foreman for possible taper and faulty work daily. Boring mill chucks are checked and spindle wear taken up when necessary.

The men, especially in this shop, are cautioned daily about safe practices, as injuries brought about by wheel and axle work are usually of a severe nature and the men are compelled to use the greatest care in the performance of their work.

Framed instructions pertaining to the work being done

at that part of the shop are placed throughout the wheel room, so that workmen may easily refer to such items as: table of mounting pressure, sketch showing system of taping second-hand wheels, code numerals covering wheel and axle defects, instructions for operating Davis expansion boring bars, allowance in thousandths for tonnage, cast and steel wheels, car wheel and axle data excerpts from A. R. A. rules, etc.

Troubles of the small interchange point

By J. Rauscher

Chief interchange inspector, Cincinnati, Ohio

As I see this matter, the trouble at small interchange points, where there is no chief interchange inspector, is that there are too many cars transferred and freight delayed unnecessarily, which results in a number of claims being filed against the railroads, and, as you all know, the cost of the transfer of a car is a small item as compared to that of claims made afterwards.

My suggestion as to the remedy for this trouble is that the local officials at these points get together, look into the situation thoroughly and figure out and adopt some definite plan to meet the situation, at all times, of course, complying with the A. R. A. rules. Cars are held up at small interchange points for transfer or A. R. A. cards, and when demand is made for this authority there is nothing left for the delivering line to do but issue it, as the receiving line is the judge as to what it will run on its line.

Of course, at large interchange points, where a chief interchange inspector is employed the situation is different as there are, as a rule, local agreements covering a great many points that cause disputes at outlying small interchange points, and, the chief interchange inspector acts as an arbitrator between the lines in interest, makes decisions as to the responsibility of defects and if the receiving line does not want to run a car that the chief interchange inspector feels is safe to run without transfer, they have the right to transfer the car at their own expense. If they are not satisfied with the decision of chief inspector and feel that they have not been justly treated, they have the right to call the Standing committee to pass on the defects. However, the decision of the chief interchange inspector at this point has not been appealed from in a number of years.

To give you some idea of our work along this line at Cincinnati, I herewith submit our report for the month of June, 1926.

Number of loaded cars received	114,417
Number of empty cars received	93,618
Total number of cars received	208,035
Number of cars set out for transfer called on	360
Number of cars ordered transferred	181
Number of cars run under load	128
Number of cars repaired	51
Number of cars set out for adjustment and ordered adjusted	140
Number of cars set out for hot boxes and found with journals cut, A.R.A. cards issued	332
Empty cars called on marked out for return movement	195
Of this number, returned	97
Repaired	78
Run without repairs	20
Cars called on for clean out orders	94
Clean out orders issued for	87
Cars called on damaged as per Rule 32	67
Cars called on for slid flat wheels	26
Cars called on for joint evidence	6
Cars called on for fire damage	2

In addition to making decisions on cases of dispute, etc., between lines as to responsibility of defects, we call on the inspectors and instruct them regarding the A.R.A. wheel gage, and make inspection of cuts for defects overlooked by inspectors, and make inspection of cars for safety appliance defects, report them to the inspectors and foremen of the lines in interest.

In Cincinnati we have two assistants and it is our duty to visit daily the shop tracks and transfer tracks and inspect cars held and make decisions to settle cases of dispute between lines. We also visit the transportation yards with the inspectors in the local and interchange yards and give decisions on any cases called on there.

Repairing dump doors on the D. & R. G. W.

By Joseph C. Coyle

SEVERAL months ago the car shops of the Denver & Rio Grande Western, Denver, Colo., were repairing a series of all-steel coal cars of the type shown in the illustration. The job of repairing the bottom dump doors presented quite a problem. They were heavy to handle, but the repair work required their removal in order to be straightened and a reinforcement of angle iron applied to the under side.

After a little study it was finally decided to handle this work in the following way. The doors were removed by hand, placed on push cars and taken to a 15-ton pneumatic press where the kinks were pressed out. They were then placed on a long trestle made of two

An A-shaped trestle was used for the final assembly

4-in. by 6-in. beams placed parallel to each other and resting on horses about two feet high. Lengths of strap iron were screwed to the top of the beams so that the doors could be easily slid along the trestle from crew to crew. The first crew stationed along this trestle bored the holes. Each door was then slid along the trestle to the next crew who keyed on the reinforcing angle iron, etc. The remaining operations were performed as the door moved along the trestle until it was ready for the riveting or assembling gangs. For this operation, the doors were removed at the end of the trestle and placed on an A-shaped trestle like those shown in the illustration. This trestle is also made of 4-in. by 6-in. beams, bolted together. This operation completed the job and the doors were again placed on push cars by the labor gang and taken to the steel shop for replacement. The successful operation of this system helped to attain a shop production of 12 cars a day.

Master painters meet at Detroit

Reports indicate possibilities of greater economies in equipment painting through new materials and improved methods

THE fifth annual meeting of the Equipment Painting Section of the Mechanical Division, American Railway Association, was held at Detroit, Mich., September 14-16 inclusive, about 140 master painters representing American railroads being in attendance. At the opening session, addresses were made by F. H. Alfred, president, Pere Marquette, and S. P. Seifert, superintendent car department, Norfolk & Western. Both speakers emphasized the increasing responsibility of the master painter in developing methods and selecting materials which will economically protect railway equipment from the destructive action of the elements. Mr. Seifert pointed out the increasing tendency to give serious study to the technology of paint and particularly stressed the importance of thorough co-operation between the painter and the chemist in order that new developments in materials and their application may keep pace with the demand for new ways of protecting modern railway equipment.

In addition to the members of the Painting Section there were in attendance at the convention, representatives of 54 manufacturers of painting materials. Arthur Orr of the Commercial Solvents Corporation presented an extremely interesting paper on lacquer finish. The increasing use of lacquer for finishing cars and locomotives has created a great deal of interest on the part of those responsible for the painting of railway equipment. In the discussion of Mr. Orr's paper, many pertinent facts were brought out. An abstract of this paper, together with a summary of the discussion, will be published in a later issue of the *Railway Mechanical Engineer*.

Election of officers

The following officers were elected to conduct the affairs of the Equipment Painting Section for the year 1927. Chairman, James Gratton, general foreman painter, Buffalo, Rochester & Pittsburgh, DuBois, Pa.; first vice-chairman, F. E. Long, foreman painter, Chicago, Burlington & Quincy, Aurora, Ill.; second vice-chairman, L. B. Jensen, general foreman, passenger department, Chicago, Milwaukee & St. Paul, Milwaukee, Wis. The following members were elected to serve on the Committee of Direction during the coming year together with six other members provided according to the regulations of the Section: H. C. Allehoff, foreman painter, Oregon-Washington Railroad & Navigation Company, Portland, Ore.; F. B. Davenport, foreman painter, Pennsylvania, Columbus, Ohio; J. W. Gibbons, general master painter, Atchison, Topeka & Santa Fe, Topeka, Kan.; H. Hengeveld, master painter, Atlantic Coast Line, Waycross, Ga.; B. E. Miller, master painter, Delaware, Lackawanna & Western, Kingsland, N. J., and D. C. Sherwood, foreman painter, New York Central, West Albany, N. Y. The members of the Section voted to hold the 1927 annual convention at Louisville, Ky.

A. E. Green (C. & N. W.)
Chairman

James Gratton (B. R. & P.)
1st vice-chairman

F. E. Long (C. B. & Q.)
2nd vice-chairman

Abstracts of several of the reports are given below and others will appear in a later issue.

Maintenance and care of paint and varnish at terminals

The committee report embodied the following recommendations for cleaning of exterior of passenger cars:

For the regular cleaning, all newly painted and varnished cars operating in regular service to receive the regular terminal washing with clear water only for the first 60 days of service or as long as the luster remains, and thereafter dry wiping, particularly in the case of wooden cars, as the water from continuously washing seeps in around window molding and other parts which causes the wood to swell and the paint to peel off in patches, permitting rapid decay.

For periodically cleaning, the exterior of cars in first

class trains and main line service are to be cleaned with oxalic acid or any approved cleaner when the condition of the cars demand it. If oxalic acid is used, after it has been applied and all dirt loosened, care should be taken that the surface be thoroughly washed with water so that no acid or dust remains on the body of the car. In renovating, the body of the car should be gone over with an approved renovator after each periodical washing in order to bring back the luster of the finish as much as possible, as well as to remove any traces of acid that might remain.

Interior cleaning of passenger cars

All passenger cars should be blown with compressed air and all dust removed at the end of each trip or when deemed necessary. When necessary to wash the interior finish, a weak solution of soap and water should be used, the finish rinsed thoroughly and dried with a cloth or chamois skin. Floors should be mopped with water to which disinfectant has been added, and care taken that no water remains on the floor, causing it to become water soaked, which is injurious to the floor and underframe. Toilets, baggage and express car floors should be washed with a disinfectant solution. Vestibules are to be washed with soap and water and dried with a cloth or chamois skin.

Painting of passenger cars

Where practical, a painter should be employed to do all necessary touching up at passenger terminals and coach yards, and care should be taken to keep painted all exposed surfaces that should be painted. This not only adds to the appearance of the car but should be done as a matter of preservation, thereby extending the period between shoppings.

Engine cleaning

Where a washing machine is available, the locomotive is to be placed on a wash track and washed with the machine. This washing should be done at the conclusion of the trip before the locomotive enters the engine-house to enable the inspectors and mechanics to do their work better. Where a machine is not available, the locomotive is to be wiped with a suitable oil, with the exception of the tender and cab which should be cleaned in a suitable manner and renovated if necessary.

The front end and firebox are to receive a suitable front end paint, and where the paint shows a tendency to scale, it should be removed and cleaned to the bare iron and repainted before the locomotive is placed in service.

The report was signed by K. J. Johnson (chairman), foreman painter, N. C. & St. L.; J. H. Whittington, master painter, Chicago & Alton; J. J. McNamara, foreman painter B. & O.; J. McCarthy, foreman painter, Canadian National; H. E. Brill, foreman painter, A. T. & S. F., and B. D. Mason, master painter, Colorado & Southern.

Report on shop construction and equipment

The up-to-date and modern paint shop should be built convenient to the car repair and cabinet shops, as these three shops go to make up a unit of one car output. We will all agree that the construction of a paint shop should be as near fire-proof as possible. The size of the shop and the number of cars on a track is determined to a great extent by the maximum output of the shop that is required.

A building or general stock room adjacent to the paint shop for supplies that come in carload lots is very essential to a modern paint shop where paint and other supplies can be drawn in smaller quantities, as required each day, thus eliminating any large quantity of combustible material in paint shop. This latter building should be of steel, brick and cement construction with raised platforms on each side the height of car doors for unloading of barrels and other heavy paint shop materials.

The paint shop stock room, as a general rule, is best situated between the main shop and varnish room, which should be at one end of building. This end of the building should be of two-story construction with dressing room, lacquer room, and stock room on the first floor, varnishing room and upholstering room on second floor, with elevator at one end for moving seat cushions and window sash, etc., for paint and repairs. Lavatories should be between the first and second floors at other end, with stairs leading to them, and continued to the varnish room above.

The main shop should be equipped with permanent staging, weight balanced so as to be operated with the foot.

The three essentials of a paint shop

In a paint shop there are three essential things to consider:

Light—Any painter will tell you it is very unsatisfactory to try and work by artificial light, therefore there should be all the light possible from the top and sides of the shop. Skylights should be situated so as to throw all light possible on the sides of cars; also the top half of shop doors should be glass so as to throw light on the ends of cars.

Heat—A railroad can build the most modern and up-to-date shops possible but if not supplied with a sufficient amount of heat during the damp cold months of fall and winter the shop is destroying the durability of the paint and varnish, rather than poor material sometimes laid to the manufacturer that supplies it.

Ventilation—This is just as essential to get the best results out of material and labor as heat, in fact the two go together; therefore a good supply of ventilators should be situated on top of the shop and regulated so as to change the stagnant air in the shop for fresh air, which is a dryer in itself.

The majority of railroads today are changing from the wooden car to the steel constructed car and a good many of the smaller roads are not equipped to take care of this class of equipment in the matter of removing the old paint from the exterior and interior of the steel passenger coaches, so that the sand blasting plant, another unit of the paint shop, has become necessary. Other methods of removing paint from steel equipment have been tried but nothing yet has been found that will equal the sand blast. This plant should be about 300 feet from the paint shop in order to eliminate dust getting in where varnish and paint are being used. No railroad should be without a plant of this kind as it is as essential for freight equipment and passenger cars.

All paint shops should be equipped with one or more paint spraying machines (a necessary evil). The spraying machine has its place on practically all railroads of the country today and the work it performs would be had to duplicate by hand. A great many railroads have gone into the spraying of equipment quite extensively using the spraying for all freight and a good part of their passenger equipment. The major part of the above-mentioned work can readily be done out of doors where the vapor is carried off but should not be done in a

closed shop without some provisions for carrying off the fumes and vapor.

The report was signed by J. T. MacLean (chairman), foreman painter, B. & M.; A. H. F. Phillips, foreman painter, N. Y. O. & W.; O. S. Minnick, master painter, W. M.; C. E. Ream, foreman painter, Penna., and W. F. James, foreman painter, A. C. L.

Painting developments with economies involved

The introduction of the lacquer system of painting is bringing about a reduction in the time equipment is held in the shop. The manufacturers of lacquer frequently figure a great saving of labor required to apply their material, because it is applied by spray. This claim should not be allowed or figured in as an economy over the enamel or varnish finish, for it is a proved fact that these materials can also be successfully applied with a spray gun. The tests on lacquer have progressed sufficiently to justify the statement that they are of great value to the painting trade.

The pro and con of lacquer

How wide the field in which they can be used depends largely on the following: It is durable? Will it give the desired appearance? Can it be cleaned in a satisfactory manner?

The experience we have had with lacquer finishing coats has been entirely satisfactory. The complete lacquer systems having the lacquer primers and surfaces, as well as finishing coats, have been successful when applied on metal, and under this method of painting the equipment can be turned out of the paint shop in four or five days. However, tests made of these lacquer primers and surfaces on wood have not been entirely satisfactory, but improvements are being made to overcome this objection. Appearance is a question of taste. Some people profess to prefer the egg shell gloss given by lacquer to the high gloss obtained by varnish. However, the manufacturers are now making lacquer finishing coats that have a high gloss, so the purchaser can secure the kind of finish desired. A lacquer finish can be more easily cleaned than an enamel or varnish finish, and from that standpoint is more economical than all other systems.

The objections to lacquer that must be considered and satisfactorily met before it is universally adopted are first, its strong odor, which is very offensive to some workmen; second, its inflammability, which, compared with other materials used in paint shops, has been, in our opinion, greatly exaggerated; third, while there are brush lacquers on the market, the lacquers that have proved their worth must be applied by a spray gun, and in some states there are unreasonable restrictions placed upon the spraying of paint materials. Your committee would, however, emphasize the necessity of installing adequate ventiliating systems wherever paint, varnish or lacquers are applied with spray. On locomotive parts, such as engine frames, wheels, trucks, rods, etc., owing to the impossibility of removing all traces of grease, lacquers are not a success as made today.

The speed at which equipment can be run through the shop by the introduction of the above methods has saved thousands of dollars that would have been required for additional shop room if the old system of painting had been maintained.

The introduction of the patent surfacer systems also effected a saving of labor because they were much easier to rub down to surface. The substitution of composition rubbing stone in place of the cake pumice stone has also been a factor in saving labor. The wet and dry grade of sand papers are now being used and by their use a further saving in labor has been effected but the same smooth surface is not maintained. Some railroads have eliminated the surface coats and only paint for durability, regardless of appearance. The committee believes that this is not true economy, as equipment finished in this way requires more labor to keep it clean and in a sanitary condition.

While the committee does not advocate a return to the elaborate scroll work formerly used, we would call the railroad managers' attention to the fact that the merchant who decorates his display window and store in a neat and attractive manner secures the major portion of the business in his line, and that there is a well defined line between what is economy, and what will repel the trade, and this line should never be crossed by a well managed railroad.

The mechanical painting situation

The greatest economy of labor ever effected in applying paints, enamels, varnishes or lacquers has been done with the spray. When sprays were first introduced, about thirty years ago, they were more properly speaking squirt guns, and applied the paint in uneven splotches and it ran and sagged in such a manner as to present a very uneven appearance, and it frequently alligatored and checked. During the World War, and immediately afterward, the spray gun was so much improved that an even coat can be applied that presents as smooth appearance as the same materials applied with a brush. In fact, it requires less experience to get a smooth job with a gun if the materials are properly mixer than to apply them with a brush.

There has been a question as to the durability of paint, varnish and enamels applied with a spray gun. Many of the devices on the market will not apply sufficient material to protect the surface. But this is not true of all spray guns.

For the successful and economical use of the paint spraying machine, the following is absolutely essential.

1—Perfect atomization of materials to be sprayed.
2—Control of air pressure and flow of paint.
3—A sufficient quantity of compressed air at all times to insure a steady flow.
4—The elimination of moisture from compressed air.

The use of paint spraying machines resulted, for certain classes of work, in a great reduction of labor cost. Under some circumstances, particularly where used in the open air when a breeze more or less heavy is blowing, it is admitted that much material is lost by use of certain types of machine painting, so much so that the saving effected in labor is more than offset by loss of material. This is particularly true of freight car painting, where the material use constitutes approximately two-thirds of the cost and labor one-third. If carefully watched, however, these matters can be controlled if a suitable and economical spraying device is used.

Shield or masking coat materials are available on the market that are a great aid to economical spray painting. This material can be applied over letters, glass, or other parts of equipment on which we do not want the spray coat to adhere, and when the car or locomotive part has been finished this shield coat can be removed with comparative little labor, thus adding greatly to economies of spray painting.

Baking paints, enamels and varnishes

A number of railroad and car manufacturing companies have installed devices to accelerate the drying of

paint, enamels and varnishes, and have thus made it possible to cut down the time equipment is held in the shop for painting to the minimum. Extensive tests run over a period of 10 years has proved that paint, enamels or varnishes, when drying, if properly accelerated, wear longer, are easier cleaned, and maintain a good appearance longer than the same materials air dried.

The sand blast is another device that has assisted in bringing about economy in painting locomotives, steel cars and structural iron and steel of all kinds. The sand blast has not only made it possible to remove old paint, flash scale, and rust from the surface, but it leaves a perfect surface, to which paint will readily adhere. The installation of patent paint burners in place of the hand torch have also added to the efficiency of the paint department.

Summing up the economies effected, as outlined above, the committee is convinced that there is absolutely no legitimate excuse for any railroad management to permit their property to deteriorate for lack of paint protection, nor is there any reason why the traveling public should be asked to ride in equipment that is unpleasing to the senses. On the other hand, the success of the several railroads that have installed specially painted and decorated trains in their passenger service is proof that the public appreciates and will patronize passenger trains that are maintained in a high class manner.

The report was signed by J. W. Gibbons (chairman), general master painter, A. T. & S. F.; B. E. Miller, master painter, D., L. & W.; F. E. Long, foreman painter, C. B. & Q.; C. W. Carter, master painter, St. L.-S. F., and B. F. Fultz, foreman painter, N. Y. C.

Report on standards—Cars and locomotives

The subject of standardizing the interior and exterior painting of passenger carrying steel equipment has become quite difficult at this time owing to the tendency of our main roads to have their passenger equipment finished entirely different from present practices.

For that reason, your committee is presenting to you, different methods of painting this equipment which may be adopted as a standard by railroads and which your committee considers good practice.

Exterior of steel equipment new or repainted when sand blasted.

First Day—Sand blast and prime with Railroad Company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Coat of surfacer.
Sixth day—Coat of surfacer.
Seventh day—Coat of surfacer.
Eighth day—Sandpaper with "Wet or Dry" sand paper and water or rub with rubbing brick and water to a smooth finish.
Ninth day—Sandpaper lightly to remove grit which may not be thoroughly washed off after rubbing and touch up with primer any spots rubbed through.
Tenth day—Coat of body color ground in japan, thinned to brushing consistency with pure turpentine, also coat of semi-gloss body color.
Eleventh day—Letter and stripe.
Twelfth day—Varnish.
Thirteenth day—Stand to dry.
Fourteenth day—Varnish.
Fifteenth day—Stand to Dry.
Sixteenth day—Varnish.

Roof and deck.—Prime with a basic chromate of lead primer followed by at least two coats of Railroad Company's standard roof paint.

Underframe, battery box fronts and steps.—When new coat with basic chromate of lead primer then apply two coats of oil color, if not new, two coats of oil color should be applied.

Trucks.—2 coats oil color.

Note:—Where a better finish is required on steps and battery boxes they should be brought along with primer and surfacer and painted and varnished with body of car.

Interior of steel equipment, new, or repainted when sand blasted.

First day—San blast and prime with railroad company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Coat of surfacer.
Sixth day—Sandpaper dry or with "Wet or Dry" sand paper and water. If sandpapered with water a day should be allowed for drying.
Seventh day—Coat of ground color.
Eighth day—Sandpaper lightly and second coat of ground color.
Ninth day—Grain.
Tenth day—Varnish.
Eleventh day—Letter and ornament.
Twelfth day—Varnish.
Thirteenth day—Stand to dry.
Fourteenth day.—Varnish.
Fifteenth day—Stand to dry.
Sixteenth day—Stand to dry.
Seventeenth day—Rub with pumice stone and water.
Eighteenth day—Polish with rotten stone and oil.

Where not as smooth a finish is desired the following schedule is recommended:

Exterior body

First day—Sand blast and prime with Railroad Company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat with surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Sandpaper dry and apply body color ground in japan and thinned to a brushing consistency with pure turpentine.
Sixth day—Coat of semi-gloss body color.
Seventh day—Letter and stripe.
Eighth day—Varnish.
Ninth day—Stand to dry.
Tenth day—Varnish.

Interior body.

First day—Sand blast and prime with standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer.
Fourth day—Putty and knife where necessary.
Fifth day—Sand paper dry and apply first coat of ground color.
Sixth day—Sand paper lightly and coat of ground color.
Seventh day—Grain.
Eighth day—Varnish.
Ninth day—Letter and ornament.
Tenth day—Varnish.
Eleventh day—Stand to dry.
Twelfth day—Varnish.
Thirteenth day—Stand to dry.
Fourteenth day—Rub with pumice stone and oil.

If enamel is to be used on interior instead of graining system same may be applied on the 5th day, 2nd coat on the 7th day and apply lettering and ornamenting on the 8th day.

A still shorter schedule we believe is proving satisfactory on the exterior of steel equipment and the schedule is as follows:

Exterior of steel equipment.

First day—Sand blast and prime with railroad company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer, surfacer to be the same or near the same shade as body color which is to be applied.
Fourth day—Putty and knife where necessary.
Fifth day—Sandpaper dry and apply one coat of semi-gloss.
Sixth day—Letter and stripe and apply first coat of varnish.
Seventh day—Stand to dry.
Eighth day—Second coat of varnish.

Owing to the fact that wooden equipment is fast going out of date your committee has not made any recommendations as to the finishes on such equipment.

Freight equipment—steel

When painting new or badly chipped and rusted open-top cars, remove rust by sand blasting, then prime with basic chromate of lead followed with two coats of carbon black or railroad company's standard color.

For all-steel box cars, after sand blasting, prime with basic chromate of lead followed with two coats of railroad company's standard body color, preferably oxide of iron.

All steel underframes should be sand blasted or thoroughly scraped clean of rust or scale, then coated with a coat of metal protector primer followed with one coat of railroad company's standard color.

Roof.—If steel, the roof should be sand blasted and primed with same material as body of car, then followed with two coats of railroad company's standard roof paint. If roofs are of galvanized iron and new, two coats of Railroad Company's standard roof paint should be applied. If galvanized iron roofs are old, rust and scale should be removed by light sand blasting and they should be primed with basic chromate of lead followed by two coats railroad company's standard roof paint.

The committee recommended that all paint on freight equipment be sprayed on.

Locomotives

A practical and economical method of painting all types and classes of locomotives by brush or spraying machine is as follows:

On a locomotive that is badly checked and cracked and the finish has deteriorated to the extent that it has become short and brittle and on newly built locomotives, your committee recommends that all old paint, rust, scale and grease be thoroughly removed from the metal, preferably by sand blasting. When thoroughly cleaned prime with a coat of metal protector primer, black in color. Putty and glaze where necessary and apply one coat of surfacer, also dark in shade.

As all steel is more or less pitted, your committee leaves you to be the judge of the number of coats of surfacer needed to build up as smooth a surface as may be desired and in severe cases would recommend that a knifing coat be used.

Sand paper and apply one coat of locomotive black finish. Letter and stripe in accordance with railroad company's standard. Varnish with a coat of engine finishing varnish (two coats on passenger and one coat on freight locomotives). The locomotive black finish and finishing varnish should be resistant to both hot and cold water.

On locomotives that have a good body, free from checks, etc., but where the finish has become dull in appearance, the engine being in shops for general repairs, your committee recommends the following:

All grease and grit should be thoroughly removed by washing with suitable solvent that will cut the grease and will not injure to the finish. Sand paper and touch up with primer, putty where necessary all abrasions, sand paper and apply one coat of locomotive black finish, letter, stripe and varnish in accordance to class of engine.

While the above schedules for passenger and locomotive painting are based on brush work, it may be well to mention at this time that spraying machines are entering into the applying of primers, surfacers and varnish quite extensively; also the lacquer system has been used by some roads quite extensively but at this time we believe is still in the experimental stage; but if they prove satisfactory will no doubt, in due time, change the standard of painting on this equipment.

There are upon the market today a number of paint spraying machines and while all are built upon practically the same principle there is quite a difference in their construction and operation. These spraying machines in the painting of railway passenger, locomotive and freight equipment without doubt will be a great labor saver, as a paint spray in the hands of a competent operator can accomplish the same amount of work that would ordinarily require three or four men with a brush. The same amount of material can be applied with a spray as a brush and just as satisfactory and in some cases more so, especially upon the steel equipment as it makes a cleaner job around the rivets and aprons.

In considering the installation of a spraying machine the following items should be given very careful consideration: Exhaust fan should be installed in the proper locations in order to lift and carry off all fumes and mist which results from spraying. Light and ventilation should be the best obtainable. Respirators and goggles should be used by operators. Where possible the spraying should be confined to one, two, three or more tracks with a partition making one room for this work. The sprays and all equipment should be taken care of and kept in good clean condition.

One more item in favor of the spraying machine, the operator can turn on the air and blow out all dirt and dust from nail holes, corners and places which are very difficult and impossible to reach with a dust brush, then turn on the material, shooting the paint into all screw and nail holes, corners and other places not reached with a brush.

The report was signed by D. C. Sherwood (chairman), foreman painter, N. Y. C.; G. H. Lehnen, foreman painter, C. & E. I.; A. E. Green, foreman painter, C. & N. W.; F. E. Long, foreman painter, C. B. & Q.; J. N. Voerge, general master painter, C. P.; K. J. Johnson, foreman painter, N. C. & St. L., and A. F. Lawson, foreman painter, P. & L. E.

Extension and feed screw for air drill

By V. T. Kropid

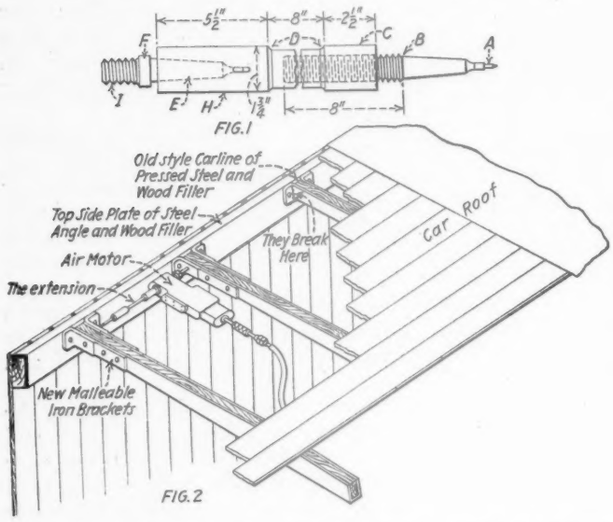
QUITE frequently the pressed steel carlines of steel frame box cars break in the bend of the foot riveted to the top side plate, as shown in Fig. 2 of the sketch, because of the rigidness of the construction. To overcome this fault, the car repair shops on this road are cutting off the feet of the carlines with an acetylene torch when the cars come in for heavy repairs and a malleable iron bracket is applied, which provides a more flexible and a reinforced joint. This necessitates the drilling of the carlines for the reception of the bolts that fasten the bracket to the carline. A close-quarter air drill must be used on account of the holes being located close to the side plate.

In trying to use the drill it was found that the feed screw was too short and that there was no efficient way of bracing the motor. This problem was put up to the toolroom machinist, and he devised a combination extension and feed screw which has proved to be successful.

Fig. 1 of the sketch is a drawing of the extension, and Fig. 2 shows the application of the extension with the close-quarters drill in operation. The extension consists of the parts *H*, which is of mild steel and is bored to

receive a No. 3 Morse taper shank, and *C*, which is made of brass and is tapped out for a 1-in. standard thread screw. *H* and *C* are joined by being acetylene welded to a piece of extra heavy 1¼-in. pipe. A 1-in. screw *B* has welded to it a No. 3 Morse taper shank, into the end of which is screwed a ¼-in. tool steel center *A*. The short screw *I* has a hexagon *F* and a No. 3 Morse taper shank *E* welded to it. The hexagon *F* is for the purpose of feeding the drill.

The extension can be used at either end of the air



The combination extension and feed screw for an air motor drill and how it is used on a car

drill by interchanging the screws *I* and *B*. When applied to the rear of the motor it is used as shown by screwing *I* into the original feed screw end of the motor. When used in front of the motor, the shank *B* is inserted in place of the drill. The screw *I* is removed and a drill is inserted in its place, the original motor center being used in this case.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Authority for renewal where material could not be properly repaired

A. R. L. refrigerator car No. 14266 was received at the Chicago shops of the Armour Car Lines on October 18, 1922, carrying Charleston & Western Carolina defect card, issued at Augusta on September 26, 1922, covering the following defects: Two corner boards damaged; twelve side sheathing damaged; five roof boards damaged; one metal tie beam bent. Joint evidence was secured and under date of November 8, 1922, the Charleston & Western Carolina furnished the Armour Car Lines with a defect card reading as follows: Two Andrews truck sides bent, 1-AL and 1-AR; one bottom section door lever bent BL; one channel spring plank bent, B; one section cross over pipe applied and one 1¼-in. dust collector omitted. October 19, 1922, the Armour Car Lines made repairs to the car and rendered a bill for $102.05 against the Charleston & Western Carolina on authority of above-mentioned defect cards. Among other items of repairs charged in the bill were two new cast steel Andrews truck sides, 405 lb. each, net $52.46, labor 5.8 hrs. The C. & W. C. took exception to the charge for the new truck sides, claiming that their defect card reading "two Andrews truck sides bent," should be reduced to cover the cost of straightening only. To this exception the Armour Car Lines replied that the truck sides had not been straightened, but had been removed and scrapped and that new truck sides had been applied; therefore, the charge for the new truck sides was proper and in accordance with the repairs made.

In rendering its decision, the Arbitration Committee stated that, "there is no evidence to substantiate that the contention that the two damaged truck sides could have been properly repaired. The bill of the Armour Car Lines is sustained.—*Case No.* 1365, *Charleston & Western Carolina vs. Armour Car Lines.*

Failure to stencil the car with the rebuilt date

On March 10, 1923, the Southern Pacific made repairs to M.-K.-T. car No. 82205, for which it billed the owner for $1,698.17. The owner objected to a charge of $30.40 for the difference between the value of a Westinghouse K-1 triple valve applied and the New York F-1 non-convertible valve removed, advising the Southern Pacific that the car in question was built during August, 1909, and requested that the triple valve charge be confined to $11.30 in accordance with Item 57-D, Rule 101, of Supplement No. 1 to the 1922 Code of Rules. The Southern Pacific refused to make a reduction to this charge, claiming that inasmuch as its billing repair card as well as its original record of repairs, indicated that the car was stencilled "Rebuilt February, 1919," the charge of $30.40 was correct and in accordance with Interchange Rule No. 101. The repairing line also stated that owing to the fact that the car was stencilled "Rebuilt February, 1919," the charge was made against the owner as prescribed in the answer to Interpretation No. 6 of Rule 17, 1922 Code.

The Arbitration Committee rendered the following decision: "The preponderance of evidence indicates that the car bore stencilling showing the original date built and, therefore, under the rules, the bill of the Southern Pacific should be corrected in accordance with Item 57-D of Rule 101."—*Case No. 1369, Southern Pacific vs. Missouri-Kansas-Texas.*

Light weight stencilled on destroyed cars to govern settlement

On January 6, 1924, six Delaware & Hudson cars were destroyed on the Boston & Maine. The car owner and the handling line could not agree on the settlement for four of the cars owing to a difference of opinion as to the light weights stencilled on the cars according to A. R. A. Rule 112, paragraph B. On January 14, the Boston & Maine received a statement from the Delaware & Hudson, giving the net value of all cars in question, the settlement to be based on the light weights of the cars. On receiving this statement, it was found that for four of the cars the stencilled light weights did not agree with the weights as given by the D. & H. The B. & M. in an effort to make settlement and close the case, agreed to accept the weights as given by the

D. & H. for two of the cars. This was done with the thought that the car owner would concede the weights on the remaining two cars. But inasmuch as the D. & H. insisted on settlement according to its records of the light weights of the four cars, the B. & M. withdrew its concession on two of the cars, basing its claim on the light weights as stencilled on the cars at the time of destruction, in accordance with A. R. A. Rule 112, Section B. The D. & H. stated that the A. R. A. rules prescribe a definite course of procedure, from which any departure in this instance was unwarranted, and furthermore, that the B. & M. did not furnish proof that the records of the owner were incorrect.

The Arbitration Committee rendered the following decision: "Rule 112, section D, provides that settlement for destroyed cars shall be on the basis of stencilled light weight on the car at the date of destruction. A reasonable interpretation of the rule would be that the weight shown on the car should govern, and that in the event the light weight of the car is not stencilled thereon, the weight as shown by the owner's records should govern. In the case at issue, the B. & M. has a clear record as to the light weights stencilled on the cars and the weights so reported should govern.—*Case No. 1370 Boston & Maine vs. Delaware & Hudson.*

Again—Rule 32

On December 5, 1922, the Southern reported for disposition under Rule 120, Atlanta, Birmingham & Atlantic car No. 10,046, at which time the usual inspection certificate was furnished. The handling line reported that, while in ordinary switching service, the car broke in two owing to its decayed and weakened condition. An investigation failed to develop that the car had been derailed, cornered, sideswiped, or that it had received any other handling which, under the rules, could be termed unfair usage. The owner contended that the fact that the car had been completely demolished was indicative that it had been derailed and thus destroyed.

In rendering its decision, the Arbitration Committee stated that "the car was not subjected to any of the unfair conditions of Rule 32. The owner is responsible.—*Case No. 1368, Southern vs. Atlanta, Birmingham & Atlantic.*

Use of billing repair card as joint evidence

On February 7, 1921, the Bessemer & Lake Erie reweighed N. O. T. & M. car No. 8767, for which work it charged, showing on its repair card the following information: Old weight, 35,800 lb., K. V., 1-18; new weight, 36,800 lb., G. S., 2-21. On January 5, 1922, the Santa Fe reweighed this car, for which work it charged, showing the following information on the repair card: Old weight, 37,400 lb., DeQ., 10-17; new weight, 34,600 lb., G. H., 1-22. Upon receipt of the Santa Fe repair card showing the subsequent reweighing, the Gulf Coast Line forwarded the Santa Fe repair card, together with the repair card of the Bessemer & Lake Erie, to the general auditor of that company, complaining that the Santa Fe card was evidence of the fact that the car was not properly stencilled after being weighed by the Bessemer & Lake Erie, and requested that the charge be cancelled in accordance with Rule 90. The Bessemer & Lake Erie refused to cancel this charge, claiming that the car had been weighed and properly stencilled as indicated by its repair card.

The Arbitration Committee rendered the following decision: "The statement of facts in this case is absolutely at variance. However, the question has been submitted to the Arbitration Committee, who, in view of the above situation, are restricted to a technical decision under the rules. Therefore, in accordance with Rule 90, the bill of the Bessemer & Lake Erie should be cancelled."—*Case No. 1367, Bessemer & Lake Erie vs. Gulf Coast Lines.*

Removal of new wheels on same road within 30 days

On March 10, 1924, the Southern Pacific applied a new pair of wheels to W.H.O.X. car No. 1430 on account of a wheel with a worn vertical flange, the other wheel being O.K. On March 14, 1924, the Southern Pacific removed the same pair of wheels on account of a rough journal, applying new wheels and charging the owner for the difference between the new wheels applied and the second-hand wheels removed. It is the contention of the United Central Oil Corporation that the charge for the second application of the wheels should be cancelled as the wheels removed had been applied only four days previously, and, therefore, the charge is not in accordance with the intent of the A.R.A. Rules of Interchange. The Southern Pacific declined to cancel its charge, claiming that it is fully covered by A. R. A. Rule 98, section and interpretation 6 of this rule.

In rendering its decision the Arbitration Committee stated that "the circumstances in this case are such as to constitute an equitable exception to Section (b) of Rule 98. In any case where the charge has been made against the owner for the difference in value between new and second-hand wheels, if they are subsequently removed on the same road within 30 days from the date of application, the charge for such difference in value between the new and second-hand wheels should be withdrawn. The same ruling will apply to axles.—*Case No. 1371, Southern Pacific vs. United Central Oil Corporation.*

Reclaiming car wheel turning lathe tools

SHOWN in the illustration are two lathe tools, the "old tool" being a standard design for turning car wheels on a wheel lathe and the "new tool" an example of how the "old tool" can be reshaped for turning car

The new tool, made from the old tool, is ground to a cutting contour at both ends

wheel journals. The "new tool" which is made from the old car wheel lathe tool after it has been worn down to its limit of length, is about 12 in. long, 1½ in. wide by

3 in. deep. It is ground to a proper cutting contour at both ends. As the tools of the old design become worn to a point where they are no longer good for service, they are sent to the blacksmith shop where they are forged into the new shape, as shown in the accompanying illustration.

This idea has been found to be quite practical by B. B. Isom, gang foreman, car department, Norfolk & Western, Portsmouth, Ohio, and by F. H. Wickes, toolroom foreman, and that by reshaping car wheel lathe tools for turning car wheel journals, there is a considerable saving in the use of high-speed tool steel. In fact, the conservation of high-speed tool steel has not been confined to car wheel lathe tools, but to cutting tools of the same material used on other machines as well. All the work to be done on the new tool on the part of the blacksmith shop is to give it the proper heat treatment.

The tool posts on the car wheel journal lathe must be altered to accommodate the shorter tools. The proper elevation of the tool is obtained by using a step ring on the tool posts. The heavier ring is desirable on account of its rigidity which if need be, will take a heavier cut and still produce a smooth surface for rolling. The new tools now in use at Portsmouth have turned 16 axles without regrinding.

After the tools received from the car wheel lathe have been used on the journal turning lathe to a point where they are too short for that work, they are sent to the smith shop and forged into a smaller section for other tools, and after this to still smaller tools, and so on to smaller sections and lengths as long as serviceable.

Clamp assists in making draw head yokes

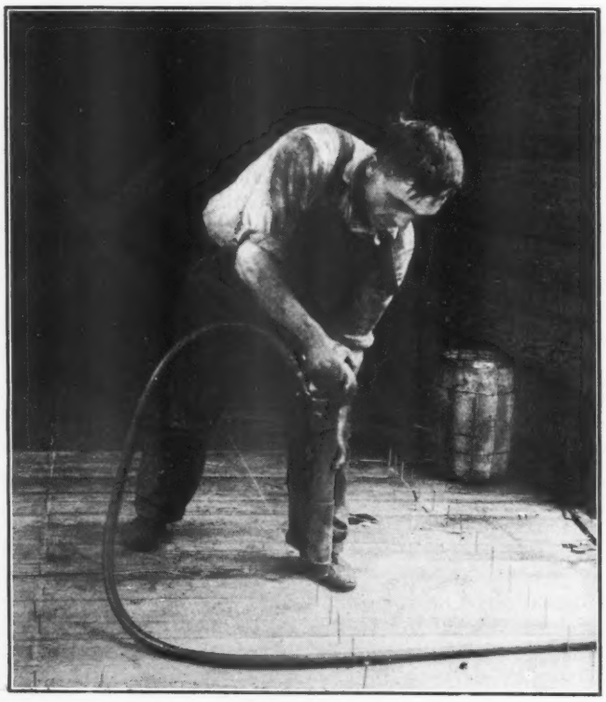
THE device shown in the accompanying illustration was designed by a car repairman to assist in properly bending the shoulders on the ends of draft gear yokes.

Couple yokes may be quickly bent in this clamp

This device is made up of two pieces of the yoke material shaped in general like an inverted vee with feet bent on the lower ends, which are bolted on the top of two heavy timbers imbedded in the earth. In the upper bend of these pieces is bolted a piece of heavy iron 2 in. thick and 3 in. wide. Another similar bar lies in the loop of the stand pieces or legs. Two iron wedges are used to drive between the top of the loops and the loose bar. The wedges are removed and the yoke material, which has been heated, is slipped between the two bars and the wedges driven in tightly clamping the piece in place. When the wedges are driven in tightly the pieces are clamped fast and heavy blows will not move them in the clamp. The ends are hammered down against the side of the lower clamp bar and finished, making a perfect right angle.

Driving nails with an air hammer

ONE of the interesting developments in car repair work is the wide variety of uses to which pneumatic tools can be put. The manufacturers of pneumatic tools furnish rivet sets cupped to various shapes as well as blanks of various diameters for air hammers. A cupped rivet set can frequently be adapted to work other than for which it is intended or can be easily altered



Nail driver in use at the car shops of the Lehigh Valley, Sayre, Pa.

for special jobs, such as driving nails. A number of car repair shops use an air hammer for driving nails in much the same manner as shown in the illustration. The set used in the hammer shown is made from a blank, although it can be made from a small rivet set. The set is cupped to suit the head of the nail and the face of the set is rounded off to the outside so as to enable the operator to sink the head of the nail in the wood. This method of driving nails is employed at the Lehigh Valley car shops at Sayre, Pa.

Tool foremen hold live meeting

Fourteenth annual convention featured by report and discussion on standardization

THE most important subject considered at the fourteenth annual convention of the American Railway Tool Foremen's Association held at the Hotel Sherman, Chicago, September 1 to 3, inclusive, was undoubtedly that of standardization, attention being centered this year on the standardization of present special boiler taps. The convention was opened with an address by L. A. Richardson, general superintendent of motive power of the Chicago, Rock Island & Pacific, followed by the address of President E. A. Hildebrandt, machine shop foreman and formerly tool foreman of the Big Four at the Beech Grove shops, Indiana. Various reports on new tools, safety devices and shop kinks for both locomotive and car shops were presented, as well as a report on labor saving tools for the air brake department. The standing committee on standardization directed its attention this year to the standardization of present special boiler taps. In connection with this report, the address by E. W. Ely, assistant director of the Department of Commerce, entitled "Simplification, a New Tool for the Tool Foreman" was highly pertinent and much appreciated by the members.

Election of officers

At the closing session of the convention, new officers for 1926-27 were elected as follows: President, O. D. Kinsey, supervisor of tools, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; first vice-president, E. A. Greame, tool foreman, Delaware, Lackawanna & Western, Scranton, Pa.; second vice-president, W. R. Millican, tool foreman, Missouri-Kansas-Texas, Parsons, Kans.; and third vice-president, H. P. Jones, tool foreman, Oregon Short Line, Pocatello, Idaho. G. G. Macina, Chicago, Milwaukee & St. Paul, Chicago, was re-elected secretary-treasurer. Three new members were elected to the executive committee which now consists of Chairman J. T. Jones, tool foreman, New York Central, Collinwood, Ohio; C. A. Schaffer, general supervisor of shop machinery and tools, Illinois Central, Chicago; J. T. Sumner, tool foreman, Michigan Central, St. Thomas, Ont.; W. J. Hynes, tool foreman, Missouri Pacific, Little Rock, Ark.; and G. F. Harney, tool foreman, New York, New Haven & Hartford, Readville, Mass.

Mr. Richardson's address

The ever-increasing weight of locomotives and the increased number of special appliances used therewith, have made necessary a considerable increase in the size and capacity of machine tools. Increased production and increased accuracy are also essential.

The general trend in railroad shops toward grinding and milling operations is going to require a more intensive analysis by our tool room men than ever before, for it is to them that we turn when the problem becomes one of extreme accuracy and close tolerances. However, the idea is sometimes erroneously entertained that the function of the tool room in a railroad shop is for the manufacture of tools; such is not the case, nor should it be. The general standard tools are manufactured by reputable concerns whose products give excellent performance. We cannot, and should not, try to compete with them when it comes to the manufacture of standard tools, such as taps, drills, reamers, cutters, etc.

There are a sufficient number of special tools required at a railroad shop to take the full time of any tool room staff in their manufacture and service, and it is to this end that tool foremen should confine their efforts in their daily work. In other words, if maximum production is to be obtained, very close analysis must be made to determine the special jigs and fixtures most economical to use. This is the peculiar function of the tool room staff, for it is only by this effort that such equipment can be developed, and it has only been through such effort in the past that such equipment has been developed.

Another important function of the tool room staff is that of repairing. This includes not only the heavy machinery in the shop but small tools such as pneumatic tools and other small equipment. It also includes the keeping of tools in first-class condition, seeing that they are properly ground, hardened and tempered.

Another function of the tool room staff, many times overlooked, is that of inspection and follow up of tools.

By this I mean that as all new tools put into service pass through the tool room, they should be carefully inspected for accuracy and compliance with standard. This means the use of gages with which every tool room should be supplied; but more important than this is the follow up of tools to determine the cause of breakage or excessive wear, and to run down the cases of mishandling and abuse, and see that such cases are corrected. It is in this capacity that the tool room foreman can save his company many thousands of dollars a year, for unfortunately there is perhaps a greater amount of money wasted in the mishandling and abuse of small tools than in any other single shop investment. The best method for the check can only be developed by individual analysis at each point.

President Hildebrand's address

This is the fourteenth annual convention of our association and should be the best. We are organized to promote the welfare of the railways by providing better tools and methods of fabricating and repairing economically the various parts of locomotives and cars. In the past fourteen years our association has done much good, but modern equipment has forced greater responsibility upon us and we have greater duties to perform. It becomes necessary that we, as tool foremen and tool supervisors, increase our efforts to meet these demands and co-operative work in the American Railway Tool Foremen's Association is one effective way to do this.

Our opportunities along the lines of tool supervision are unlimited. They challenge the best that there is in us. To meet this challenge and capitalize on its opportunities, we must collectively study our mutual problems.

We have passed the experimental stage in our association and the good work of the past shows that we have not labored in vain. While we can feel proud of the work done, we are still on the surface, and there was never a time in the history of our association when our co-operative work and best thoughts were more needed than now. There are many intricate problems in our special field which are difficult to solve, except by combining the experience of many practical tool men.

The topic, "Labor Saving Devices for the Air Brake Department," I believe, is entirely new, and as the air brake department generally takes care of the small accessories such as injectors, lubricators, whistles, pops and the numerous cab valves it becomes necessary that we have the proper tools to maintain this equipment and the many different ideas you have should make a splendid discussion.

"New Tools and Safety Devices for the Car Department" is a topic which covers a large field. Heretofore we always had this combined with locomotive jigs and devices but since there are many car shops which have their own tool foremen I believe the idea of getting a paper in their interest only, will bring some of the car shop tool foremen to our conventions. We certainly want such members and I am certain the papers pertaining to their work will be more thoroughly discussed.

"General Locomotive Shop Kinks and Devices" is a topic that never grows old. There are so many ways of improving old methods or applying new ones to the repair of the modern locomotive that any member who hears this discussion should be well recompensed for the time he has spent here.

Another one of our topics is the "Standardization of Present Special Boiler Taps" which is only a part of our standardization program, yet one of the most important subjects we are confronted with. Standardization of tools is probably the biggest and most progressive movement our association has undertaken. Problems of the greatest importance confront us in this undertaking and if we carefully and properly solve them we can get wonderful results. Let us become thoroughly acquainted with this subject so we can intelligently discuss it and be able to present something of value to the American Railway Association. We must adopt our standards with some definite end in view if we are to serve a useful purpose. Just consider for a moment what it would mean if the manufacturer could carry only one style thread for boiler work and one style reamer for locomotive work. Could not these tools be manufactured cheaper and be sold cheaper with the results that the railroads would be saving in the end? Then again, were you to manufacture these tools in your own tool rooms, would it not mean that you would have to carry a lot of raw material in stock which is capital tied up and would go as overhead expense.

"Training Men Suitable for Toolroom Work" is a topic we have given little thought to until this year and I believe it is one of the most important subjects we have to deal with. The men that you select or who wish to follow toolroom work must have certain qualifications or they will never make a success of tool work.

There will be numerous personal topics which the members will talk over among themselves. No tool foreman has ever attended a convention who has not had some good idea of his own which he was willing to exchange with someone else, so you can readily see that you can receive from others as well as you can contribute to them. And the more you get acquainted the more you will come in contact with the live problems of the day.

Report on training men for tool room work

A tool maker is said to be the aristocrat of the metal working trades. There must be a reason for it, for to be worthy of such a title he must be a man of keen discernment who can look a situation over from various angles, both inside and outside before arriving at a conclusion. He must have confidence in himself so that if he is sent out in the shop to see why a certain reamer, although having a keen edge, will not cut, he may be told by the operator that the trouble is in the steel, but having been taught to investigate for himself, he takes the tool out, looks at the hole and finds it is doing more rubbing than cutting. Thereupon he takes a hone stone and eases the bearing back of the cutting edges slightly and replaces the tool which then works in a very satisfactory manner.

A foreman who has men and boys entrusted to his care to learn a trade should first recognize the importance and the responsibilities of his task. He should prepare himself to teach the things he has learned from years of experience. Tool room foremen are skilled in tool room work but the "Mastery of a vocation is, taken by itself, no guarantee of power to teach that vocation." Much can be learned on this subject from such books as Spencer's "Education" and Paynes' "Method of Teaching Industrial Subjects." It is well also to study the different apprentice systems of our railroads and other industries.

In the selection of men for tool room work some practical experience and a knowledge of men is of great help. If we were privileged to review a line of men with the intent of selecting help for the tool room we would not want to be attracted particularly with the fine physique nor the muscular development of the individual. We

would most likely look him in the eye to discover if he has that bright alert expression in his face that indicates he is quick to grasp an idea and fully alive to everything going on about him. He should have at least a grammar school education, although a high school graduate is preferable, and have the mental capacity to see little things and understand the reason for tools being master products.

In training a boy whom we will expect some day to shoulder the responsibilities of our shops, the greatest care and precaution should be taken in the beginning to get the boy's interest aroused in his work in order to get him to put forth his best efforts in learning to do each task well.

The man with his mind centered on the clock is not interested in his work and will not produce the quality or quantity of work that the man will whose heart and soul is with his labors. It is well to bear in mind that a boy is learning only while he is busy working; all other time is a loss to himself as well as the company. Therefore, keep plenty of work ahead of him, but not enough to cause him to rush from one job to do another.

When the boy starts to work in the tool room it is the foreman's duty to get him interested in the possibilities of tool work as a life work. If he does this and maintains this interest the teaching of the trade becomes a pleasurable task. Any boy that does not become interested, if properly handled, should try some other class of work.

The boy is then assigned a machine to operate, being first shown how to keep the machine properly oiled and cleaned. He is then given a job to perform, preferably something of which he may be furnished a finished sample so that he may have a better idea of what is wanted. He should be allowed to examine samples of work that do not come up to standard if possible and be shown wherein they are below standard. He is then shown how to perform the job by a demonstration by the foreman or a skilled mechanic, being told why each operation is performed in the manner that it is. After this demonstration he should be allowed to take the machine and do the work himself, always being mindful that quality comes before quantity in tool work. Eventually he will naturally acquire speed from practice. It does not suffice to show him once only, but it is necessary to watch him and correct wrong methods. He should also be given some idea as to the monetary value of the piece of work upon which he is engaged, the value generally being enough to set him to thinking in tool work.

It is said that the first impressions are the most lasting, consequently the boy should spend the first six months in the tool room so as to familiarize himself with the routine of work; then six months on machine work in the machine shop; six months in the erecting shop to see and learn how tools are used in actual service; six months in treating of steel and the remainder of the time in the tool room.

A simple system of grading whereby an apprentice is kept informed as to the progress he is making compared with other apprentices on similar jobs will be beneficial.

A library which is accessible to all tool room employees is of much value. This library may contain such books as the proceedings of the American Railway Tool Foremen's Association, various hand and reference books, a great many books furnished by machine tool manufacturers and small tool catalogues. The men should also be encouraged to subscribe for good railway publications that deal with their work.

Looking at the matter from the point of view of the individual, the first need is that each man shall find something to do and do it well. He may then make a study of the conditions most likely to secure progress. The man who becomes a skilled workman or manager does not necessarily begin in the occupation in which he eventually achieves success, but he puts his energies in motion and then uses his power of initiative. Every man must learn to be thorough, to hold out. This means much concentration on the task at hand with the view of cutting down the waste, to see wherein work as well as conditions may be improved.

A man must think, acquire, control and store knowledge. If he looks around him he sees it is the man who has worked hard and faithfully who succeeds. What men need above all things are initiative, creative ideas and definite plans of action to which they can give themselves with vigor.

Everybody knows that if a positive man makes a mistake he is not long in rectifying it, but the uncertain man who never does anything without first consulting everyone else and then is always opening the question for reconsideration will never accomplish anything. Men who are made of the right kind of material do not make excuses; they work. They do not whine, they keep forging ahead. They do not wait for somebody to help them, they help themselves. They do not wait for an opportunity, they make it. Men who make opportunities are wanted everywhere.

When a man finishes a piece of work he should be able to say, "There, I am willing to stand for that piece of work. It is not pretty well done, but it is as well done as I can do it; done to a complete finish; I will stand for that and am willing to be judged by it."

In conclusion, it is necessary that in order to insure the making of a good toolroom apprentice, there must be a perfect understanding and co-operation between the apprentice and his foreman; then there will be no lost motion or wasted effort.

The report was signed by: Chairman J. J. Sheehan, tool foreman, Norfolk & Western, Roanoke, Va.; H. C. Starke, tool foreman, Union Pacific, Los Angeles, Cal.; E. J. McKernan, supervisor of tools, Atchison, Topeka & Santa Fe, Topeka, Kan.; R. R. Drake, tool foreman, Pennsylvania, Canton, Ohio, and J. C. Howard, tool foreman, Fort Worth and Denver City, Childress, Texas.

Simplification—A new tool for the foremen

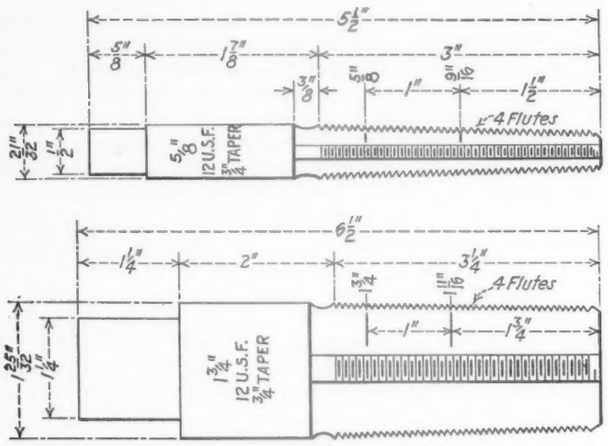
By Edwin W. Ely, Assistant Director, of the National Committee on Metals Utilization.

American business life is universally regarded from the three viewpoints of production, distribution and consumption. The tool foreman is a "producer" insofar as he shares in making possible the vast amount of passenger and ton mileage, and he is a representative "user" when it comes to consuming the tools, machines and other equipment that emanate from outside industries. In both capacities he stands in a position to enjoy the advantages of simplification—it is actually a new tool in his hands.

With a minimum variety of sizes and types of interchangeable parts entering into railroad car construction and repair, and with a reduced number of tool variations in use, the tool foreman should experience greater facility in effecting replacements and repairs. It is also reasonable to expect that the production of ton-miles and passenger-miles would be materially increased. The main objective of the tool foreman is to keep rolling

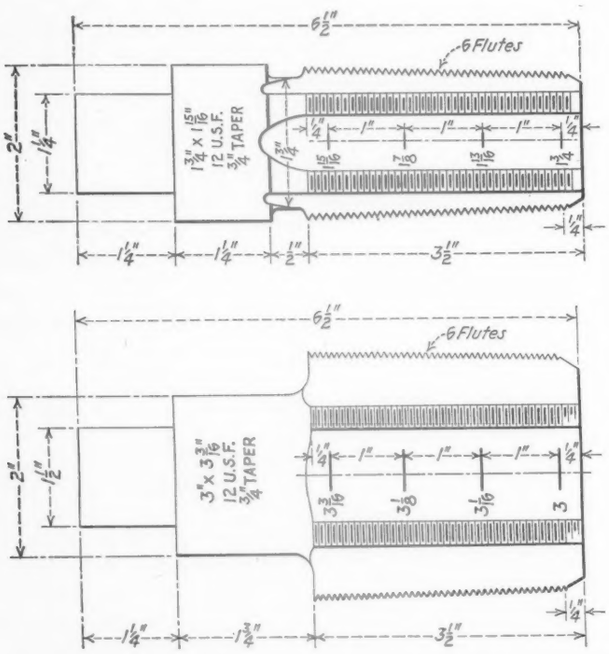
stock moving as fast, as far, and as long as possible without repairs.

Two types of opportunity offer themselves to the railway tool foreman. One is through a study of the needs of his road and how to cut down excess variety of equipment parts, tools, etc., so that stores and stocks may be

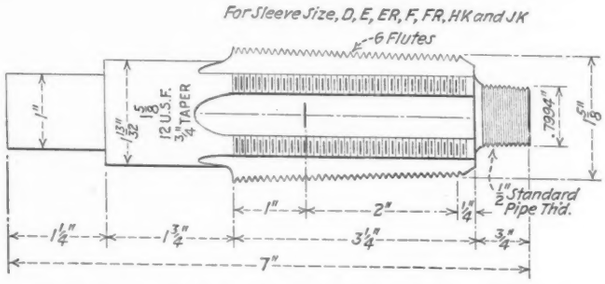


Drawings A and B—Smallest and largest of 10 sizes of taper boiler taps

reduced to a minimum compatible with adequate service. The other lies in the direction of reclamation, which practice is today saving millions of dollars annually. In the former there is an opportunity for the railway tool foreman to take advantage of, and co-operate in, a movement which is becoming more and more general throughout industry—that movement known as *simplified practice*. Simplified practice is another name for group action by manufacturers, distributers and users of any commodity, for the purpose of accomplishing three things; first, to study *all* the facts about existing variation in size, pattern, model, etc., and to acquire a knowledge of the existing demand for each of these variations; second, to determine from the available facts whether some cannot be omitted from production and use without interfering with the needs of the user, and to take joint action in eliminating the superfluous items; and third, to stick by the joint action and to watch closely the changing trends due to invention or improvement which might necessitate a revision of the program.

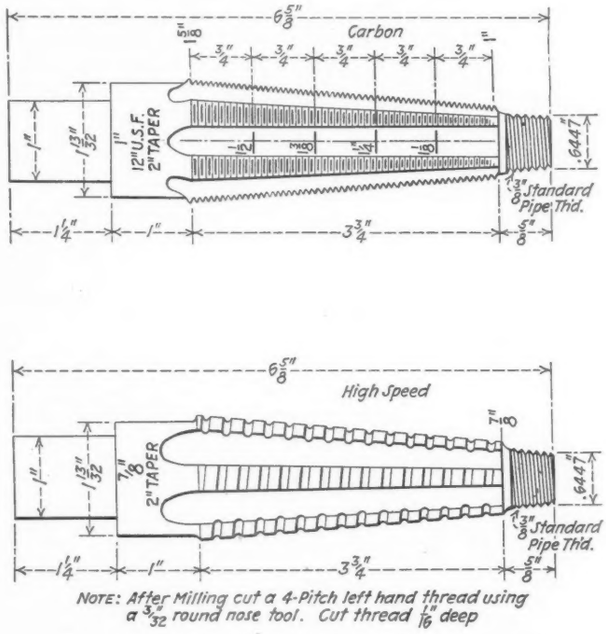


Drawings C and F—Largest and smallest of 11 proposed standard washout taps



Drawing G—This tap proposed in 1⅝-in. 1¾-in., and 2 1/16-in. sizes

While the tool foreman is engaged in the mass production of but a single item,—mileage,—he is a user of many commodities found in the open market. As a user the tool foreman is in a position to confine his requirements to the minimum number of sizes, dimensions, varieties, etc., of the things he buys for the railroad he represents. With rhyme and reason applied to the pur-



Drawing H—Taper head radial tap and reamer

chase of stores and equipment, the foreman makes it possible for the manufacturers of the articles in question to fabricate them at a lower cost, and he places himself in a position of having to pay less for them. He may thereby reduce the size of his store-room and cut down the expense of his monthly inventory.

There are many commodities which have been passed through the regular procedure of the Department of Commerce, and which are of particular interest to the railway tool foreman as a consumer. Some of these are:

files and rasps, forged tools, steel lockers, milling cutters, grinding wheels, chasers for adjustable die heads and other small tools.

The American Railway Association has done a fine job in weeding out excess variety in such items as boiler lagging, carriage bolts, hexagon head machine bolts, square head machine bolts, locomotive boiler rivets and structural rivets. In all, the reductions amount to 1,240 out of the 1,676 previously used items.

Individual roads in the United States are making great strides in standardization matters. Some instances read like these: "eliminated 3,020 items in six and one half months," "644 items eliminated," "eliminated 4,859 items, and an active committee expects to produce several thousand further reductions," "eliminated 2,471 items in seven classes," "unable to give figures at this time, but we are in the midst of a special campaign of simplification that should produce real results."

(In closing, Mr. Ely, placed the experience and facilities of the Department of Commerce at the disposal of the American Railway Tool Foremen's Association in securing the greatest good from the constructive work that has already been done by that Association's standardization Committee, and in initiating surveys that would lead to further economies.)

Report on standardization of present special boiler taps

The object of this report is to establish standard equipment whereby the railroads may purchase standard tool equipment from manufacturer's stock instead of having it made special to individual orders at higher cost. A standards committee of the American Tap and Die Association worked with your committee in developing the standards herewith submitted, to whom we are indebted for many valuable suggestions and improvements in designs.

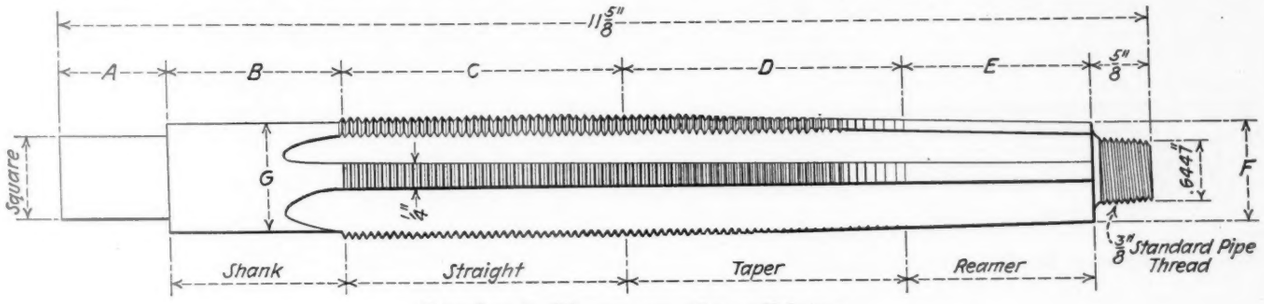
This proposed standardization is also in line with the recommendations made by the committee appointed by the American Railway Association as reported at this year's convention held at Atlantic City as regards their recommendations covering form of thread and taper, etc. Your committee has taken up the work where the A. R. A. left off and has gone into details of design with a view of effecting a definite standardization and higher development of more efficient tap equipment.

We recommend the adoption of the United States form of thread as the American railroad standard and the elimination of the sharp vee-form of thread entirely. The Whitworth form of thread is approved by this committee but is not recommended as a national railroad standard.

For boiler studs and similar work we recommend taps as shown on drawings *A* and *B*. The specifications are as follows:

United States form of thread.
Taper ¾ in. in 12 in.
Number of flutes—Four.
Two size lines to be plainly stamped or etched on the flute to indicate where the size is taken; this to insure the standard diameter holes being tapped.

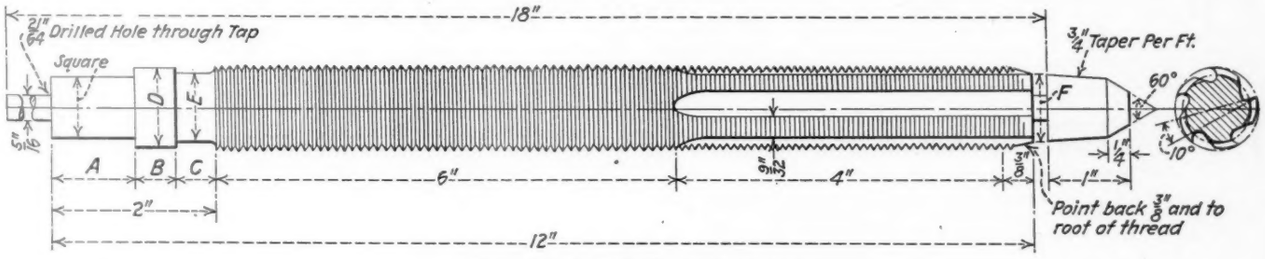
The designs take into consideration the importance of a full thread in lapped sheets so that studs will project or be flush with the inner surface and thus avoid pockets and resultant pitting. These taper boiler taps advance in ⅛ in. steps and the design provides for proper



Drawing I—Wagon top pilot radial tap

Table of wagon top pilot radial tap sizes

Size	Square	A	B	C	D	E	F	G
1"	5/16"	3/4"	2 1/4"	3"	3"	2"	13/16"	7/16"
1 1/16"	5/16"	3/4"	2 1/4"	3"	3"	2"	7/8"	7/16"
1 1/8"	3/4"	1"	2"	3"	3"	2"	15/16"	1"
1 3/16"	3/4"	1"	2"	3"	3"	2"	1"	1"
1 1/4"	3/4"	1"	2"	3"	3"	2"	1 1/16"	1"
1 5/16"	7/8"	1 1/8"	1 7/8"	3"	3"	2"	1 1/8"	1 3/16"
1 3/8"	7/8"	1 1/8"	1 7/8"	3"	3"	2"	1 1/16"	1 3/16"



Drawing J—Spindle staybolt tap

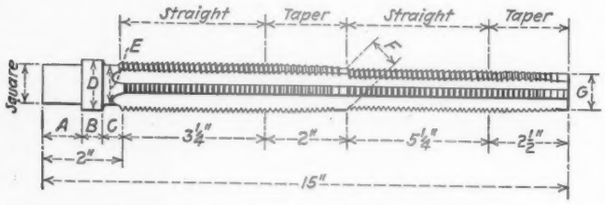
Table of spindle staybolt tap sizes

Size	Square	A	B	C	D	E	F	No. flutes
1	3/4	1	1/2	1/2	1	7/8	7/8	5
1 1/16	3/4	1	1/2	1/2	1 1/16	15/16	15/16	5
1 1/8	3/4	1	1/2	1/2	1 1/8	1	1	5
1 1/16	7/8	1 1/8	1/2	3/8	1 1/16	1 1/16	1 1/16	5
1 1/4	7/8	1 1/8	1/2	3/8	1 1/4	1 1/8	1 1/8	5

follow-up between taps. Attention is also directed to standardized squares, all 1/16 in. sizes being eliminated.

For washout plugs and other boiler head mountings we recommend taps as shown on drawings *C, D, E* and *F*; these taps to be United States form of thread and ¾ in. taper in 12 inches.

All taps have a standard square shank (size 1¼ in.) and an even number of flutes is provided so that the size may be taken off by calipering if desired. These



Drawing K—Combination staybolt tap

Table of combination staybolt tap sizes

Size	Square	A	B	C	D	E	F	G	No. flutes
⅛ x 1 1/16	¾	1	½	½	1 1/16	⅛	⅛	⅛	5
⅛ x 1⅛	¾	1	½	½	1⅛	1	1	⅛	5
⅛ x 1 3/16	⅞	1⅛	½	⅜	1 3/16	1 1/16	1 1/16	⅛	5
⅛ x 1¼	⅞	1⅛	½	⅜	1¼	1⅛	1⅛	⅛	5
⅛ x 1 5/16	⅞	1⅛	½	⅜	1 5/16	1 3/16	1 3/16	⅛	5
1 x 1⅛	¾	1	½	½	1⅛	1	1	⅞	5
1 x 1 3/16	⅞	1⅛	½	⅜	1 3/16	1 1/16	1 1/16	⅞	5
1 x 1¼	⅞	1⅛	½	⅜	1¼	1⅛	1⅛	⅞	5
1 x 1 5/16	⅞	1⅛	½	⅜	1 5/16	1 3/16	1 3/16	⅞	5

taps advance in ⅛ in. steps and size lines are plainly stamped or etched as shown. The design allows for proper follow-up between the several sizes and also connects up with the point where the stud taps leave off. Another reason for six flutes on all sizes is to permit a worn-out tap to be reworked into the next smaller size.

For flexible stay bolts we recommend taps as shown on drawing *G*; these taps to be United States form of thread and ¾-in. taper in 12-in., with 1-in. standard square heads; all taps to have six flutes and a ½-in. pipe thread pilot. The object of a pipe thread for the pilot is that, being taper and a fine thread, it is stronger than a coarse straight thread such as is usually furnished; also a common piece of pipe and a coupling will serve as a pilot.

For taper head radial stays we recommend the tap and reamer shown on drawing *H*. These taps to be United States form of thread, 2-in. taper in 12-in. with 1-in. square head and ⅜-in. pipe thread for pilot. This drawing shows six flutes, however, five flutes would possibly be more desirable.

Our reason for not showing a taper shank on the reamer is to overcome changing sockets in the motor. Such roads as have standardized on Use-Em-Up spindles in the air drills will no doubt prefer such shanks on both the tap and reamer.

For wagon top work we recommend the wagon top pilot radial tap as shown on drawing *I*. These taps to be United States form of thread, straight and with a ⅜-in. pipe thread pilot.

For spindle staybolt taps we recommend the taps as shown on drawing *J*, these taps to be United States form of thread and straight with the exception of the point which is tapered ⅜-in. in 12-in. with a full thread and chamfered ⅜-in. on the point to permit starting.

For combination stay bolt taps we recommend the taps as shown in drawing *K* and for the combination radial stay taps as shown on drawing *L*, which completes our recommendation.

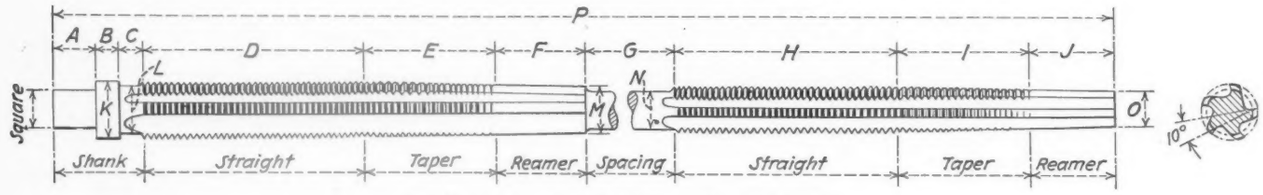
This report is of course subject to correction and it is hoped that this preparatory work will serve as a basis for final standardization. Your committee has not offered any recommendations on the straight stay bolt taps for the reason we have found a great difference of opinion as to the best design.

We hope this tap may be discussed and an agreement reached on a satisfactory standard as these taps are an item of considerable expense on every railroad.

The report was signed by O. D. Kinsey, Chairman (C. M. & St. P.); A. H. Gray (P. & L. E..); G. L. Nelson (M. S. P. & S. S. M.); F. H. Kreuger (Erie); and S. H. Ehrenstein (S. P.).

Discussion

On motion of C. A. Shaffer, general supervisor of shop machinery and tools of the Illinois Central, the association concurred in the A. R. A. recommendations of ¾-in. taper per foot, 12 threads per inch and U .S. form thread, recommending the lengths shown on drawings *A* and *B* and approving the design of taper boiler taps suggested by the committee with the exception that the taps be necked to the bottom of the thread and back a distance of ⅜-in. from the thread. This change was made to prevent damage to boiler threads on account of over-running. The balance of the taps were adopted without change except those on drawings *E* and *F*, in which it was recommended that the squares for tool shanks be increased to 1½-in. on all taps 2½-in. and over.



Drawing L—Combination radial staybolt tap

Table of combination radial staybolt tap sizes

Size	Square	No. flutes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1 x 1⅛	¾	5	1	½	½	6	3	2	0	6	3	2	1⅛	1	1	⅞	⅞	24
1 1/16 x 1 1/16	⅞	5	1⅛	½	⅜	6	3	2	0	6	3	2	1 3/16	1 1/16	1 1/16	1	1	24
1⅛ x 1¼	⅞	5	1⅛	½	⅜	6	3	2	0	6	3	2	1¼	1⅛	1⅛	1	1	24
1 x 1⅛	¾	5	1	½	½	6	3	2	6	6	3	2	1⅛	1	1	⅞	⅞	30
1 1/16 x 1 1/16	⅞	5	1⅛	½	⅜	6	3	2	6	6	3	2	1 3/16	1 1/16	1 1/16	1	1	30
1⅛ x 1¼	⅞	5	1⅛	½	⅜	6	3	2	6	6	3	2	1¼	1⅛	1⅛	1	1	30
1 x 1⅛	¾	5	1	½	½	6	3	2	12	6	3	2	1⅛	1	1	⅞	⅞	36
1 1/16 x 1 1/16	⅞	5	1⅛	½	⅜	6	3	2	12	6	3	2	1 3/16	1 1/16	1 1/16	1	1	36
1⅛ x 1¼	⅞	5	1⅛	½	⅜	6	3	2	12	6	3	2	1¼	1⅛	1⅛	1	1	36

General foremen meet at Chicago

Importance of modernizing shops stressed—Foreman and apprentice training recognized as vital factors

THIS year's attendance and the excellent papers and addresses presented at the convention of the International Railway General Foremen's Association, held at Hotel Sherman, Chicago, September 7 to 10, inclusive, indicate an increasing interest in the activities of this organization. A well balanced program, speakers of recognized ability in railroad work and a keen interest in the discussion tended to emphasize the success of the officers of the association in their efforts to make the organization a factor in establishing the importance of the general foreman's position in the mechanical department.

Addresses were delivered by E. L. Woodward, western editor *Railway Mechanical Engineer*, L. C. Dickert, superintendent motive power, Central of Georgia, D. C. Curtis, chief purchasing officer, Chicago, Milwaukee & St. Paul, F. H. Becherer, superintendent car department, Central Railroad of New Jersey, and M. A. Hall, superintendent of machinery, Kansas City Southern. During the seven sessions of the convention papers were presented and discussed on the following subjects: Balancing Shop Sub-Departments in Locomotive and Car Departments; Development of the Mechanic; Maintenance of Refrigerator Cars; The General Foreman's Responsibility for Material Surplus or Shortage; Developing Railroad Shop Foremen; and Modern Shop Equipment as a Factor in Increased Production.

Election of officers

The following officers were elected to serve during the year 1926-27: President, C. A. Barnes (Belt Railway of Chicago); first vice-president, F. M. A'Hearn (Bessemer & Lake Erie); second vice-president, J. N. Chapman (Illinois Central); third vice-president, C. F. Bauman (Chicago & North Western); fourth vice-president, J. H. Armstrong (A. T. & S. F.), and secretary-treasurer, William Hall.

Abstracts of some of the addresses follow and others will appear in subsequent issues of the *Railway Mechanical Engineer:*

Possibilities of the General Foremen's Association

By E. L. Woodward

Western editor, Railway Mechanical Engineer

The possibilities of the International Railway General Foremen's Association for promoting better railroading are so closely allied with what general foremen individually and as a class can do as to be practically incapable of separate discussion. No distinction will therefore be made in this paper. General foremen are responsible to no inconsiderable extent for the efficiency with which Class I railroads in the United States spend over $1,200,000,000 annually for maintenance of equipment. About 60 per cent of this amount is for labor in repairing cars and locomotives—and the general foreman is primarily a co-ordinator of labor, with the first duty of getting his men to work efficiently and together. Forty per cent of maintenance-of-equipment expenditures is for material—and on the general foreman's judgment depends to a considerable extent the saving or waste of material.

The increasing responsibilities of general foremen are evident from an examination of Table I which shows that for one reason and another the cost of keeping cars and locomotives in serviceable condition on American railroads has trebled in the past 15 years. Locomotives have increased 10 per cent in number and 60 per cent in total power during that period. Freight cars have increased 11 per cent in number and 35 per cent in total carrying capacity. Wages have gone up and hours of labor per day gone down. Will the cost of maintaining cars and locomotives continue to mount, or will the concerted efforts of general foremen and other mechanical department officers and supervisors be successful in reducing it? That the increase has been checked at least temporarily is shown by the close similarity of the 1924 and 1925 figures, but probably no general foreman will dispute that, taking the railroads as a whole, substantial reductions in present maintenance costs can be made without decreasing either the quantity or quality of the work. This should be the general objective of the International Railway General Foremen's Association and of the individual members who compose it.

Table I.—Maintenance-of-equipment expenses, Class I railroads, labor and material

1911	$415,590,400	1919	$1,226,532,195
1912	436,995,458	1920	1,590,364,640
1913	499,988,331	1921	1,251,479,444
1914	520,200,274	1922	1,249,038,676
1915	496,739,561	1923	1,462,222,167
1916	557,664,332	1924	1,256,369,892
1917	685,428,913	1925	1,256,378,353
1918	1,103,031,350		

Some additional figures of interest bearing on the number of men supervised by railway general foremen are shown in Table II, these figures being furnished, as are those in Table I, by the Bureau of Statistics of the Commerce Commission.

Table II.—Number of men on Class I roads in 1925, supervised by general foremen

General foremen (maintenance of equipment)		1,498
Assistant general foremen and department foremen		11,648
Machinists		9,229
Blacksmiths		61,265
Boiler makers		19,802
Car men		
Class A	22,447	
Class B	4,445	
Class C	87,086	
Class D	2,278	
Total car men		116,256
Total employees on daily basis		17,026
Total employees on hourly basis		507,486
Total labor cost (M. of E. in 1925)		$805,085,910

It will be noticed that this table shows 1,498 general foremen employed on Class I roads and, for maximum effectiveness, the International Railway General Foremen's Association should have a membership at least approaching that figure. In fact, it might be even more, as the assistant general foremen and some of the department foremen may well be considered eligible for membership.

Membership of 500 not final objective

I recall distinctly that the first thing President Warner said, after accepting his re-election last fall was, "let's get to work." This was characteristic, and he, in conjunction with Secretary Hall and the other association

officers and committee men have labored many hours to make this convention the largest and best ever held by the association. They arranged the program which is, I think, notable for the importance and diversity of the subjects considered, as well as the number of ranking mechanical department officers secured as speakers. They set an objective of 500 members in attendance this year which is very creditable but must be considered only a step in the right direction if this association is to achieve the power and influence possible of attainment by it in the railroad world.

Another striking fact shown in Table II is the great preponderance of car men over any other classification. Locomotive men may take precedence in mechanical department councils because, without motive power, trains cannot move. It is equally true, however, that locomotives are valueless as revenue earners without cars, and there are 2,358,000 freight cars in service on Class I railways as compared to 64,150 locomotives. The task of maintaining these cars efficiently is a tremendous responsibility of railway general car foremen, whose problems and difficulties deserve a large share of the time and attention of this association.

General foremen must study men

The general foreman's main problem, and therefore a subject for discussion by this association, is that of men—their selection, training and handling. Apprentices must be watched and encouraged, helpers promoted, mechanics advanced, department foremen developed and induced to work together in harmony.

The general foreman who thinks long years of experience have taught him all there is to know about this subsubject is fooling no one but himself. Some of the brightest minds of this generation are devoting their entire time to solving problems of personnel, and their observations and findings are available in a broad way in books and magazines, more intimately by personal contact with the authors. It is doubtful if any general foreman is living up to his full possibilities unless well read on this subject of personnel handling.

Moreover, it is becoming the function and duty of general foremen to combat false propaganda among workmen by giving publicity on bulletin boards and at shop meetings to the real facts about railroad operation, costs, taxes, earnings, etc. Accurate information secured from the management and properly broadcast to shop men will do much to improve their morale, make the shop atmosphere more conducive to efficient work and increase shop output.

Shop methods are a distinct responsibility of general foremen, and much of shop efficiency is dependent on the methods selected, the way work is routed or scheduled from one department to another, the machinery chosen for specific operations. General foremen need to attend this and similar conventions, visit other shops and read all the pertinent literature available to keep up to date on methods. And it must be admitted that in at least some railroad shops it is not so much a question of keeping up to date as getting up to date.

Machinery and shop equipment should receive the special attention of general foremen who are in a strategic position to furnish data proving to higher executives the justification for buying more powerful, modern machines. Since 1911, locomotives have increased approximately 10 per cent in number and 44 per cent in average power and weight. Locomotive accessories have multiplied rapidly, and yet the attempt is being made to maintain this modern power in many shops and enginehouses built in 1911 or before and improved little if any since. Similar conditions obtain at many car shops where the situation is aggravated by the attempt to repair steel cars in shops originally designed to handle wooden cars only. This subject of steel car repairs is a vital one at the present time. General foremen may feel that if their immediate superiors are apparently uninterested in improved facilities "they should worry." The answer is that, being closer to the work, they are in a better position to know just what antiquated shop equipment is costing the railroads.

Next to stabilization, new wage system is most important need

The installation of modern machinery and up-to-date schedule systems may bring about a marked improvement in shop operation and increased output. Experience has shown that the operation will still be only about 66 per cent efficient, however, unless the present common system of daily wage payment is replaced by some method of paying men in proportion to the work they do. This is the greatest need of railroad shops today, next to stabilization of employment. Attempts are being made at a number of points to solve the problem, in some cases by piece work and in others by some form of bonus system. General foremen should keep in touch with these developments and be prepared to advise their managements what type of wage payment system will probably best meet the needs of their individual shops.

Another crying need in many railroad shops today is a more accurate computation of the locomotive repair, car repair and shop order work on a man-hour basis. This is necessary to a real knowledge of costs and checking of the relative efficiencies of various methods and departments. The progressive general foreman wants to know exactly what conditions are in his shop and how his operation this year compares with last. The answer is to compile labor records on a man-hour basis.

Put equipment through the shops faster

Still another subject of intense interest to higher executives at the present time is the utilization of railroad equipment. A modern locomotive costs, roughly speaking, $80,000, a passenger coach, $40,000 and a freight car, $3,000. Every day this equipment is in the shop for repairs it not only earns no revenue but incurs a substantial interest charge. Some roads are taking 30 days or more for Class 3 repairs to locomotives, including new flues and heavy repairs to machinery. Passenger cars are in the shop 25 days or more for heavy repairs and burning off old paint. The possibility of having a fewer number of cars and locomotives in any given shop at the same time, working a larger number of men on each unit of equipment and putting the equipment through the shops on shorter schedules may well be considered by the railroads as a whole and by this association.

This paper will be closed with a few suggestions "for the good of the order" which may be summarized as follows: The International Railway General Foremen's Association needs (1) a larger and more representative membership from railroads in the various sections of this country, (2) continually better convention programs, (3) more intensive work by committee members other than chairmen, (4) more critical and general discussion of committee reports, (5) more definite action on important questions at issue, (6) more widespread publicity for the work of the association and (7) a keener appreciation of the possibilities of the association and of its individual members in the more efficient spending of the railroad dollar. It is not common for any man to underestimate the importance of his own job, but somehow general foremen frequently get so bound up in details

and so close to their individual work that they lose all sense of perspective and fail to see how their efforts can best fit in with those of other mechanical department officers.

To achieve the seven objectives outlined in the preceding paragraph, the best brains of this association should be mobilized in a committee, each objective studied in detail, suggestions sought from the entire membership and from outside friends, and a program of work laid out which will make this association the power it ought to be for better railroading in this country.

The development of the mechanic

By C. L. Dickert

Superintendent of motive power, Central of Georgia, Savannah, Ga.

Which produces the best results, regular apprentices, helper apprentices or train specialists? This subject has been before the railroad world for many years and has aroused great interest and called forth much discussion.

This is particularly true in the case of the college educated man. There have been many articles written pro and con on this subject and, while it is true that college men have made failures, it is not due to the college education, but to the individual himself. Physique, mentality, morals, and mechanical experience being equal, the college educated man has a distinct advantage over the non-college man. I refer, of course, to the technically educated college man.

In support of this statement, I might quote from an article I read recently in the Railway Age concerning the college man's chances: "In the last four years thirteen of the most important railroad companies have elected new presidents. Of the retiring presidents of these railways only two were college educated men. On the other hand, of the thirteen new presidents, seven are college men and only six are non-college men."

I must admit that there are at present many men who are non-college men, that have risen to high positions, but the college man is fast coming to the front. I do not mean to say that the non-college man has no chance, for he has, but the fact remains that there is a growing demand that he be broadly educated. The boy who through no fault of his own has had no chance to get an education beyond grammar-school may go in the shop and become a first class machinist, boilermaker, etc. As a machinist he may be able to handle any machine known to a railroad shop. He may be able to go into the erecting shop and do perfectly any of the different things which are necessary in the erection of a locomotive. He may develop into a good executive and may finally become a foreman, a general foreman or a shop superintendent. On the other hand, suppose we have a technically educated boy, who has all the qualifications of the other. Of the two, who should make the best superintendent of motive power?

Up to a certain point the non-college man has equal chances with the college man, for, as a machinist, boiler maker, blacksmith and on through the list, everything being equal they are told what to do and knowing how and both do it to the best of their ability. Their responsibility ends when the job is done. As a gang foreman or assistant foreman, they are generally directed and guided by the foreman in charge, or should be. Up to this time both of them have opportunities to show their natural ability, but as they go on up, they meet more and more mechanical problems which have to be solved and surely the technically educated man must naturally have the advantage. Assume that these two boys, after a certain length of time are sent to the drafting department which one is going to be the most efficient in working out the many problems which arise and which in many instances, require a knowledge of higher mathematics?

I have, at various times, while reading articles on the question of the college man in railroad work, seen the statement that college graduates fight shy of the railroads. This may have been true in the past and to some extent at the present time, but why? Owing to the fact that railroads in general have paid very little attention to the education of apprentices in the past, there has been very little inducement offered the college man and then again, because the average college man is very ambitious and desires to start at the top. This, of course, is where he makes his mistake. He realizes that he has spent four years in college and when he finds he must spend approximately the same time in the shops before he can become an educated mechanical man, he becomes discouraged. This condition can be overcome by the co-operative system which we have in operation on our railroad.

This system has been in operation only three years with us, but we feel that it is going to produce splendid results. It is operated in conjunction with the Georgia School of Technology, this school having taken up the co-operative plan in 1912, when they had an enrollment of twelve. In 1925 the enrollment was 330.

Personally, I think the co-operative plan preferable to the regular insofar as the mechanical student is concerned, as it enables him to combine his practical experience with technical theory, and thus be prepared to start out in the mechanical world well equipped.

A very important feature of the co-operative plan is the fact that the boys come in daily contact with their fellow employes who have not had the opportunity of going to college. An insight into sociology, economics, ethics and psychology may be had by this contact with their fellow workers, which could be obtained in no other way and at the same time the student is learning what a shop and railroad is.

The co-operative students are divided into two groups or sections, and while section one is at college getting their class room work, section number two is at work in the shops. At the end of four weeks this order is reversed. The course extends through five years, the student being allowed only three weeks' vacation, two in the summer and one during the Christmas holidays. These students not only go to college through five years, but they put in more hours daily, as they have 30 weeks a year at school, while the regular student has 36 weeks a year in his four-year term.

In order to enter college, these boys must be graduates of an accredited high school or its equal and the railroad company doesn't consider any student unless he has fulfilled all of the college's conditions. When the student has been accepted by the college and the railroad, he is then assigned to one of the shops most convenient for the student. In other words, he is assigned to a shop, if possible, in the city in which he lives. This, of course, cannot be done in every instance and the student who cannot be so located has to pay expense at both ends.

You will understand, of course, that the co-operative student is paid for his time while at work, his rate of pay depending on the industry or corporation with which he is working. In some cases these boys are able to pay practically all of their expenses, particularly after the first year, but these cases are few, and depend largely on the individual. As you may know, this plan is particularly helpful to the boy who cannot afford to take the

regular course where he is at a dead expense, so naturally, they take the co-operative plan on account of the financial aid they receive, but I am sure as time goes on the mechanical students of the future will realize the superiority of this plan over the regular course as mentioned before.

We have at present, 84 of these students, 42 per section divided between four shops in proportion to the size of the shops and the amount of work done. They are entitled to all the privileges of the regular students at college and to those of all other employees of the railroad company.

Their time is divided between all departments of the shop, the foreman in charge being the judge as to when a change is to be made. Here, of course, arises a problem, for where one student might become proficient in a certain length of time, another one may take twice as long. These and other problems connected with the plan will, of course, be smoothed out in time. In addition to shop work, these boys spend a certain length of time in the drafting department and the testing laboratory. In fact, it is our idea to give them a complete shop education and when they graduate, we will pick such as we desire to perfect, and carry them along with the idea of producing supervisory material.

At present we are developing two grades, mechanical and electrical, our plan being to combine the two for three years. At the end of three years the student can determine whether he wishes to follow the mechanical or electrical line and we feel that with three years of general shop work he should be able to perfect himself in the work he wishes to pursue.

Our company starts these students in at a liberal rate of pay and give them an increase every six calender months.

While this plan was started on our road only three years ago, we have five boys who graduated in June, having served two years with other industries before the Central of Georgia took up the plan. We decided to take the five in our service and at present one of them is employed in the test department and handles the tensile test machine, makes coal analyses and other work of like nature. Another of these boys is being used in our largest shops in doing special engineering work. The other three elected to perfect themselves in erecting shop and roundhouse work.

This plan does not eliminate the regular apprentice, and we continue to take in these boys. We still feel that the non-college man must have his chance and we are, therefore, giving him the opportunity to prove his worth. If the boy is ambitious and wants to progress through work and study, we provide the means, as we conduct an apprentice school through the winter months. We have as instructors in this school, teachers from the manual training department of the local high schools together with certain of our foremen, and the boys are taught drawing and elementary mathematics, as well as certain principles concerning locomotives, cars and shop work in general.

Discussion

In discussing Mr. Dickert's paper, T. C. Gray, supervisor of apprentices, M. K. & T., directed attention to the fact that the three classes of apprentices—regular, helper, and special—serve three distinct purposes. He mentioned the fact that the helper apprentice on the M. K. & T. is gradually being eliminated. He expressed the opinion that from the ranks of the regular apprentices should come the skilled mechanics, shop supervisors and, in some cases, higher mechanical officers. The training of special apprentices, however, should be directed to the production of technical experts and an occasional mechanical engineer and superintendent of motive power. "It seems to me," he said, "that the two aforesaid classes of apprentices fill a much needed want and the training problem is of much more importance that the question of the relative value of the two. Mr. Dickert does not say that it is essential that a gang foreman be a technically trained man. This does not leave many places demanding a technical education. It would be interesting to know the number of special apprentices that could be taken care of in a period, say of 10 years."

Mr. Gray took exception to the value of training apprentices in the drawing room. He pointed out that while it is especially desirable that a machinist develop the ability to read working drawings accurately and rapidly, it is much more desirable to devote the greater part of his training to the development of skill in practical work. He emphasized the desirability of training apprentices to make accurate sketches, rather than finished working drawings.

C. Y. Thomas, supervisor of apprentices, K. C. S., was of the opinion that the apprentice training method in effect on the Central of Georgia as described by Mr. Dickert would tend to develop more technically trained men than a single road could possibly make use of. His remarks indicated that he felt the most important function of apprentice training should be to develop a sufficient number of practical mechanics who, through further training, could be developed into supervisors and that the railroads should draw from the colleges the technically-trained men that are needed in their organizations.

Committee report—Material surplus or shortage

The office of the general foreman in the railway shop is, to a certain extent, an auxiliary to the purchasing and stores department. The general foreman's position is such that he is enabled to help or to hinder the efforts of the stores department in giving satisfactory service by having necessary materials on hand at all times, without having an accumulation of slow moving or obsolete material.

A survey of material cost against locomotive mileage shows that in classified repairs the material cost may run in excess of 50 per cent of the labor cost, while in running repairs it may be as low as 10 per cent of the labor cost. Probably a conservative estimate would be 60 per cent labor and 40 per cent material during the service life of the locomotive. This percentage, while varying due to the size of power units and local conditions, may safely be taken as at least 10 cents per locomotive mile run for locomotive material. From information available we believe that $10,000,000 a month is a low figure to represent the expenditure for materials used in locomotive maintenance of the railways of the United States. It therefore follows that, if it lies within the power of the membership of this organization to effect a substantial reduction, either in the amounts of stock carried or in the amounts actually drawn for use, it is important that the efforts be made.

On December 31, 1920, shortly after the end of federal control of railroads in the United States, Class 1 railroads had in stock material with estimated value of $755,563,278. At the end of 1924 the value of material held in stock by the same railroads had been reduced to some $530,000,000. An approximate reduction of 30 per cent was accomplished during the four-year interval.

A few words as to the cost of carrying surplus material for railroad shop use might be of interest. Investigation gives some variations in opinion upon this subject. U. K. Hall, general supervisor of stores, Union Pacific System, recently made the statement at Atlantic City that "The consensus of opinions of experts who have studied this subject has been that it costs from 15 per cent to 25 per cent to carry material." Mr. Hall at this time also submitted an itemized division of the costs as shown by R. M. Hudson of the United States Department of Commerce at Atlantic City on June 10, 1925. Mr. Hudson's estimated charge was 25 per cent. Some railroad representatives who have been questioned upon the subject estimate from 10 per cent to 20 per cent. We submit these figures merely to show that slow moving materials for which the general foreman is in a measure responsible, are a greater cost to the transportation companies than might appear to the mind of the average mechanical man. As to material shortage, each and every general foreman knows only too well the cost of shop delays brought about by inability to secure material when needed. The desired position and relations between the mechanical department and the stores department would be a quick turnover of materials for the stores department interests and an ample supply of materials at all times subject to the demands of the mechanical department.

An interesting light upon amounts of materials needed is shown in the answer of I. H. Lance, general storekeeper, D. L. & W., to the inquiry of your committee which eliminates one of the most popular excuses that an increase both in the number of items carried and in the total value of items carried was an inevitable part of the growth of modern locomotives and cars. We learned that this road on July 1, 1918, carried 58,000 items of material. June 1, 1926, these items had been reduced to 38,000. We quote our authority literally in this statement "This reduction in the number of items carried in stock resulted from standardization and elimination from stock of items which we found it unnecessary to carry.

"My experience * * * indicates very clearly that a mechanical department, as well as other departments, are not likely to call attention to surplus materials, but, on the other hand, they are very loud in their complaints when a shortage exists. This, however, does not apply to our road as we have the utmost co-operation of our department heads, and this is one of the reasons we have been successful in reducing our stock balance. If it is made known by one in authority to foremen in a mechanical department, or any other department, that they must interest themselves in materials for the purpose of eliminating surpluses and avoiding shortages as far as possible, I think this would be a good beginning.

"In the beginning foremen will undoubtedly show indifference, but if the proper pressure is brought to bear, they will soon realize they have a responsibility in assisting to maintain a minimum stock. Of course, we, like all other railroads, have a stock book which shows the movement of materials and this is a very good weapon to use when showing foremen when materials become inactive and when unnecessary to carry in stock. Of course, there are certain items of materials that must be carried for emergencies which are more or less inactive. With changing conditions it is absolutely necessary that materials be constantly checked with the departments using them and I have described above our methods of doing this and I attribute to this constant checking a good share of our stock balance reduction."

A periodical examination of stock lists and issues in order to detect slow moving or non-essential material seems to be a duty of certain mechanical department representatives. There are representatives on many roads that have shown notable results in stock value reductions. Mechanical department representatives may see many opportunities in the course of their work to divert slow moving materials into channels where they will be used. Minor alterations of slow moving or obsolete castings or parts will often enable their disposition by other means than as scrap.

Standardization of parts cannot be too strongly stressed. Probably no one other action taken by the mechanical department will make for the solution of the material problem under discussion more than this one.

Utilize to the fullest extent the aid and advice of service men of the various supply companies in matters pertaining to their own particular products. The suggestions of these specialists will often serve to avoid unnecessary renewals of parts discarded through lack of proper judgment on the part of the mechanic or removed as a matter of shop routine. Careful workmanship at repair periods and proper maintenance and proper supervision of right repairs will greatly increase the service of equipment between shoppings and inevitably secure a longer service life of the parts that compose the equipment unit.

Use of modern repair methods in the application of long service materials to various wearing surfaces, as for example, bronze wearing surfaces on cast iron cylinder or valve tee rings, bronze or steel removable plates on driving boxes, and any other repair methods that are practiced to certain extents in some shops, but do not become general practice in all shops as rapidly as they should.

There is a decided variation in shop practices in the matter of establishing wear limits to locomotive parts. While it would not be practicable to say, for example, that all locomotive driving box bearings for power of certain sizes should be run to some arbitrary condemning limit, one usually finds that practice in the matter of scrapping such wearing parts is subject to wide differences of opinions.

Another angle of this variation in shop practice is found in the method of some roads of re-boring worn locomotive valve bushings once only, and to whatever size they will make up, contrasted against other roads that have reamers varying by ⅛ in. in size; by which means valve bushings are re-bored three times. Still other roads may establish a wear limit the same as mentioned in the second case, but may vary their sizes by sixteenths instead of eighths. It is certain that some of these practices possess advantages over others.

We find that locomotive and car department general foremen by assuming their share of responsibility for material surplus and shortage have effected savings in many ways. Shop delays, unnecessary items, inactive stocks, obsolete parts, and serviceable materials being lost as scrap are all being lessened through their efforts. At the same time a closer understanding between departments work for a mutual betterment for all involved.

The report was signed by F. M. A'Hearn, chairman, B. & L. E., Greenville, Pa.

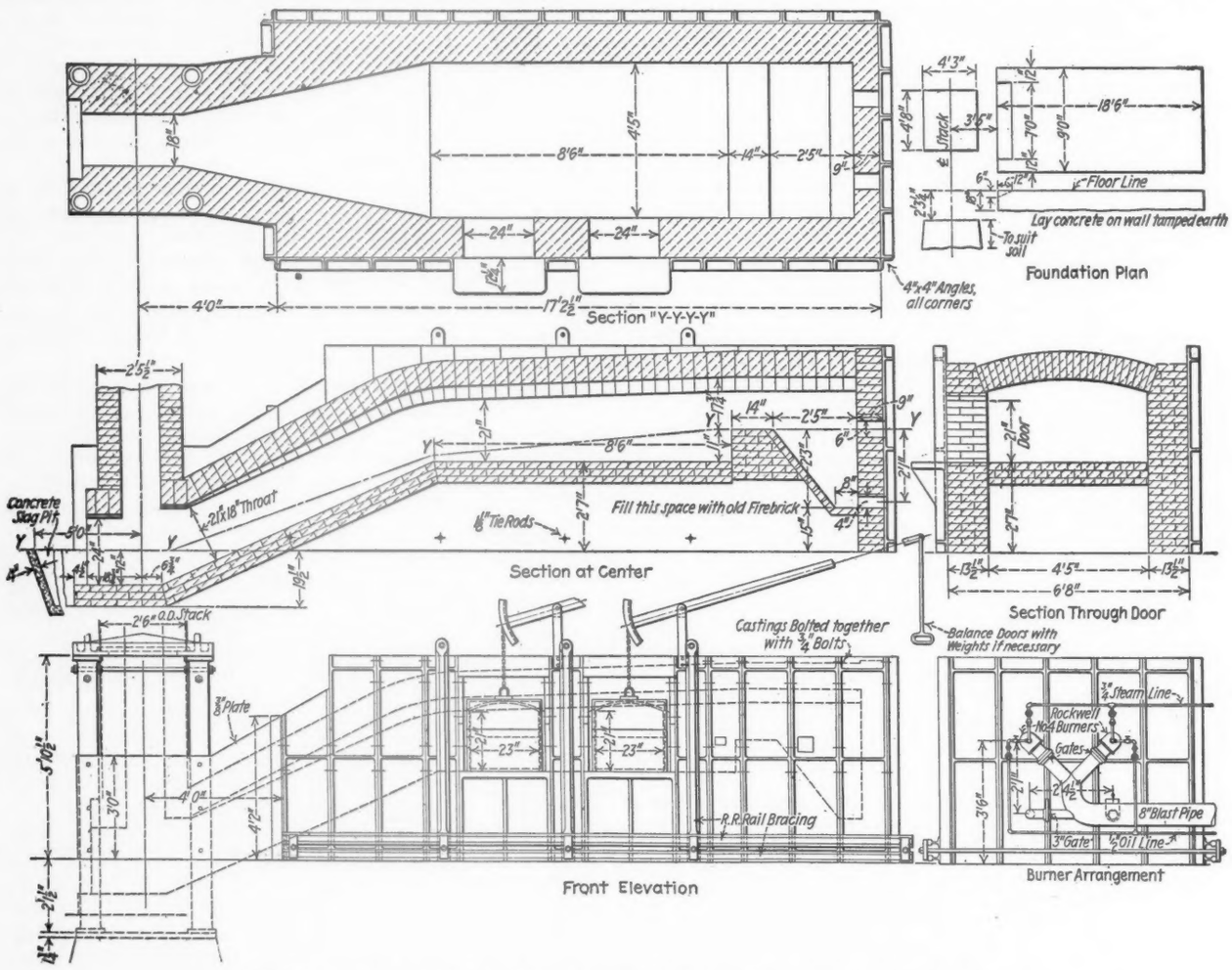
THE BALTIMORE & OHIO has advanced the pay of shopmen from one to two cents an hour; and work on Sundays and holidays, performed by men not regularly on duty on such days is to be paid for at the rate of time and one-half. The increases which went into effect September 1, include machinists, boilermakers, blacksmiths, sheet metal workers, electrical workers, car men, car cleaners and preparers, and apprentices in all classes.

Economically operated forging furnace

By Glenn L. Davis

THE design of forging furnaces is always the subject of much discussion and speculation in the drafting rooms of railways that design and build this part of their forging equipment. This condition is not entirely due to the lack of data on the subject, or because manufacturers of furnaces have lagged behind other industries in research work, but is due mainly to the fact that furnace troubles are frequently due to the condition of the outside of the furnace rather than to mistakes in design. This statement must be construed to mean that such conditions as irregular blast pressure, oxidizing of the work on account of improper combustion within the hearth; third, flare-out or excessive heat at the charging doors of the furnace, making charging, removal and heat gaging difficult, and fourth, excessive operation and maintenance costs caused by one or the other of the defects listed above or to a combination of these defects.

Having all of these possibilities in mind, the average designer of shop facilities who is concerned with forging furnaces only occasionally, usually looks about for some type of furnace that has functioned with a minimum of trouble under average conditions and copies it with such minor modifications as are necessary to his particular needs. Such a furnace—one that has demonstrated its worth in hard service over a period of many months—is shown in the accompanying illustration. It is an oil-fired adaptation of an older type of down-draft, coal burning forge. It has the usual bridge wall for the baffling and



Working drawing of a forging furnace designed for economical operation

faulty building ventilation, poor fuel improperly supplied, the use of the furnace for heating cumbersome pieces for which it is not adapted and poor setting or bricking of the furnace, will bring on heating troubles more often than will poor designing, which to a great extent, can be detected and remedied before the furnace is built.

Nearly everyone who has to deal with forging problems knows too well, all of the usual difficulties which arise in the day-to-day operation of forging furnaces. These difficulties may be briefly enumerated as follows: first, uneven heating of the work owing to hot and cold spots within the hearth or heating chamber; second, excessive distribution of the heating gases and the rectangular hearth or heating chamber with sloping roof, double charging doors and down-draft conduit leading to the stack. The brick walls and cast iron casing of the furnace as well as the burners, blast piping and doors are of the conventional type.

Particular attention is called to the setting of the burners with the center lines on a level with the top of the bridge wall and also to the arrangement of the auxiliary blast piping under the burners to direct the gases upward and cause them to impinge against the sloping roof. This arrangement of the burners, blast and baffle insures an

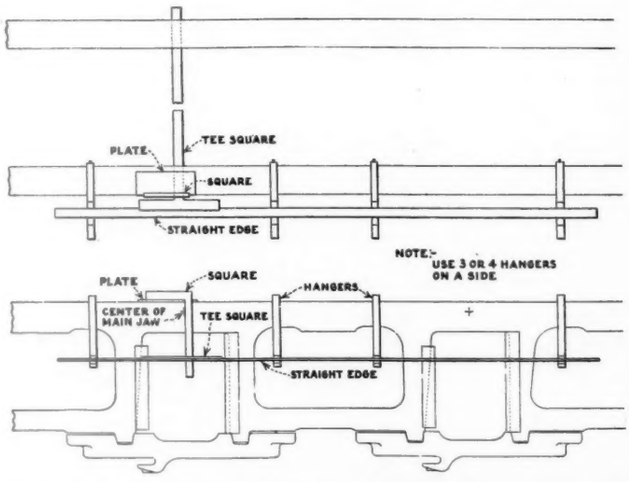
even distribution of heat within the hearth and, since there are no hot and cold spots within the hearth, the lining and casing of the furnace are not subjected to excessive strains with their corollaries of cracking, warping, etc. Hence, the maintenance costs on these particular hearths are low.

Another feature in the operation of this furnace has been the almost complete freedom from flare-out. In handling such work as old axles or billets which must extend beyond the doors while being heated, it has been found necessary to use a minimum of luting around the work. Generally, old fire bricks laid so as to seal the opening under the half open door, have been satisfactory as a seal, without the addition of dirt, cinders or other material. While the first cost of the furnace shown, because of its length, may seem objectionable to some designers, it must be remembered that the final economy of any facility, measured by demonstrated service is a far truer index of actual cost than the figures denoting the initial outlay.

According to the builder of this furnace, who is a blacksmith foreman of long experience, it is inadvisable to attempt to scale down the dimensions on this plan in an attempt to build a furnace of, say one-half the hearth capacity of the one shown. Height of bridge wall, distance of burners from the wall, dimensions of draft conduit, etc., are all subject to minor variations to suit local conditions and while furnaces built to the sizes shown have proved their worth in various localities and under varying conditions, the drawing must still be regarded as representative of a simple, effective type, rather than a specific recommended installation for all blacksmith shops. It must be noted, too, that attention to little details, such as hooding the stack at night to prevent back draft and subsequent cracking of the stack lining, has probably helped in establishing the good service record of this furnace.

Laying out shoes and wedges

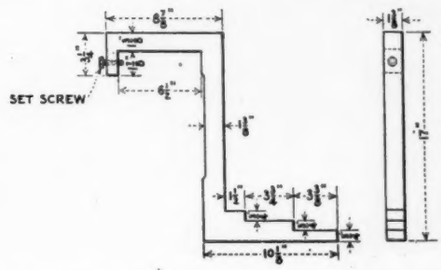
THE method employed on a mid-western railroad for laying out shoes and wedges incorporates the use of long straight edges, held in position along both sides of the frame on hangers, a detailed drawing of which is shown in one of the illustrations. Three or four hangers are



Method of holding a straight edge along the frame jaws when laying out shoes and wedges

located at convenient places along the frames and held securely by set screws. The three hanger steps provide for setting the straight edge out beyond the brake hangers or other castings on the frames. The straight edges must be set parallel with the frames.

After the straight edges are in position, the distance from the face of the cylinder to the center of the main jaw is obtained from blueprints. This measurement locates the center of the main jaw, which is marked about two inches down from the top of the upper frame rail, as indicated in the illustration. The corresponding center must then be located on the other frame. In order that the square will set properly, the top of the frame is scraped and a plate used on which the butt of the square rests. By placing the square on the jaw center line, it is transferred down to the straight edge. The T-square, having a shoulder on its head which rests on the top of the straight edge, is then held against the straight edge and brought up against the square, after which the same square



Detail of the hanger for supporting the straight edge along the side of the frame

is similarly used on the other side to transfer the line to the top frame rail.

In order to prove that the frames and jaws are square, the above operation is repeated for the frame on the opposite side. The lines thus made should check, otherwise the T-square or the square are not accurate or the top of the frame may be warped.

The centers of the other jaws may then be located, according to the rod lengths, by tramming from the centers of the main jaws, and the shoes and wedges laid off in the usual manner.

The engine truck center casting and the trailer lead pin casting are marked and located accurately. Both the engine and the trailer trucks are known to be square before they are placed under the engine. A gage is used for turning the tires and all contours are thus made the same. From a center located between the faces of each axle, the hub liners are trammed to insure their being identical. If not, they must be made so.

The spring saddles, driving boxes and springs are checked to be sure that the distance from the top of the journal to the spring seat is the same in all cases. The equalizers are drilled on the same centers, as are the spring hangers.

An important operation is that of checking the springs for height when free, depressed one inch and for total load. This check is made on a spring tester. If any spring is found which does not test to the requirements, it is re-set so as to conform with the others. Old springs are tested and paired so as properly to distribute the weight on both sides of the engine.

When the engine is ready to leave the shop, it is placed on a stretch of straight level track and the distances from the rail to the springs are checked to be sure that they all correspond.

It has been claimed that the first locomotive laid out in this manner made about 30,000 miles with very little flange wear. The riding qualities of the engine are reported as being excellent.

Assembling Baker valve gear

By J. H. Hahn

Machine shop foreman, Norfolk & Western, Portsmouth, Ohio

THE accompanying illustration shows a frame for assembling the bell crank, reversing yoke, radius bars and gear connecting rods of the Baker valve gear to test the alinement of these parts and to see that all parts are properly fitted up before sending them to the erecting shop. This frame is made of a standard gear

This device is made of a standard gear frame for the Baker valve gear

frame for the Baker valve gear which is supported on legs made of 12 in. channel iron or other suitable material.

The bosses that the lower ends of the radius bars fit in have been machined off flush with the face of the gear frame, and vee blocks have been bolted on in their place as shown in the illustration. Studs with keyways in the lower ends instead of threads are used to hold the caps on the vee blocks. The radius bars are placed in position in the gear frame and the caps placed over the studs and then tapered keys are driven in to hold the caps.

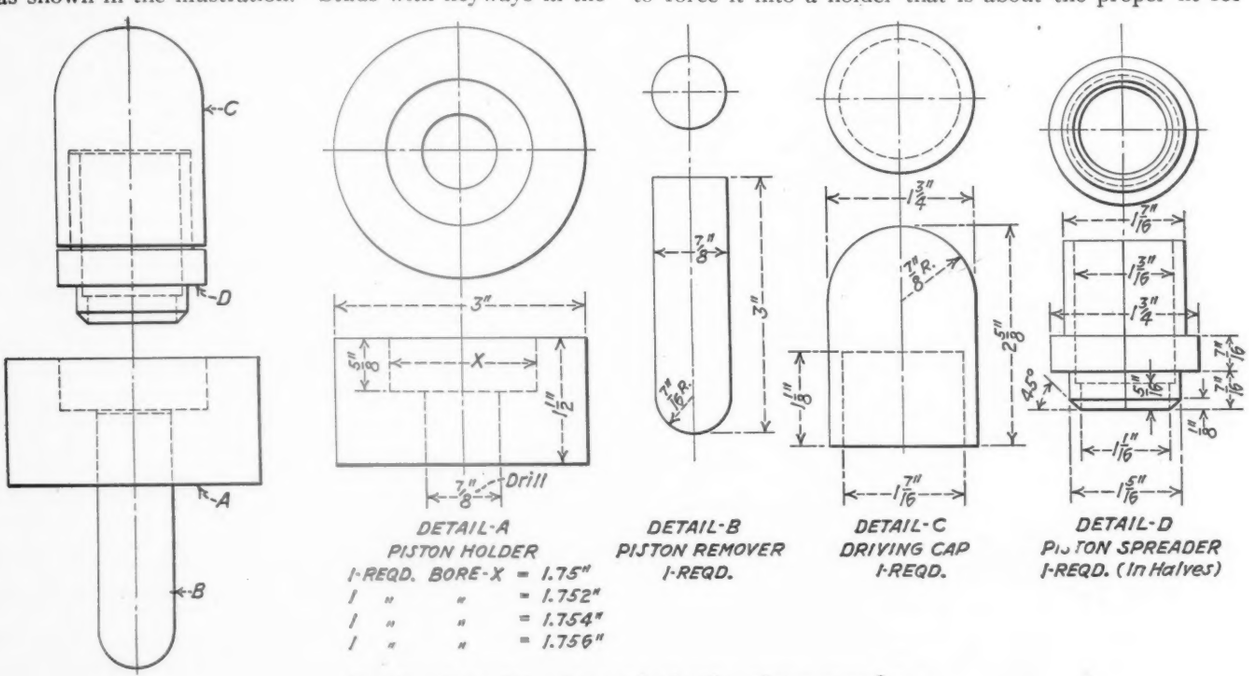
Feed valve piston spreader

By H. J. Duernberger

A PRESSURE feed valve piston does not contain piston rings and when worn, either must be spread to fit the bushing or be thrown away. The majority of the feed valve piston spreaders now in use upset only one or both edges of the piston which soon wears off and leaves the piston too loose to give the proper leakage fit. The sharp edges quickly ruin the bushings.

The accompanying illustration shows a tool designed to spread as wide a surface of the piston as possible so as to save the bushing and also to have the piston fit last much longer. The best way to use the tool is to have the four piston holders, detail *A*, arranged in a row in a solid, heavy piece of metal at the rear of the work bench or test rack, close to where the feed-valve is bolted on the test bracket. These holders increase in size from 1.75 in., which is the standard size of the feed valve piston, to 1.756 in. by increments of .002 in. Where other than standard sizes of pistons are used it is advisable to make piston holders to fit each size. These should be made in steps of .002 in. larger in size than required for the standard size of pistons. When a feed valve is found that has a piston too loose to give the proper leakage, the piston and supply valve is removed as a unit. Detail *D*, which is in two parts, is slipped over the slide valve and into the groove on the piston. The driving cap *C* is slipped over the spreader and then the piston is tried in the four holders to determine the one which fits it the closest. When the piston is in the proper holder, hit the driving cap a light tap and then try the piston in the feed valve, and if still too loose, spread it further until the right fit is obtained. If the piston sticks in the holder, drive it out with the piston remover.

If the piston is worn out of round, it is good practice to force it into a holder that is about the proper fit for the piston and then drive it down solid into the holder which will throw the metal out on the worn spots to the fit of the holder. A great many times the rounding of the piston will be sufficient to give the proper leakage fit.



Details of the Duernberger feed valve piston spreader

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Grease for lubricating trailer truck journals

PERU, Ind.

TO THE EDITOR:

Since reading the editorial on "What about trailer truck lubrication?" which was published on page 77 in the February issue of the *Railway Mechanical Engineer,* I have been turning over in my mind the special emphasis laid on the lubrication of engine truck and trailers on locomotives used for long runs of 500 to 800 miles. This is one subject that has been neglected for a number of years, in fact one might make it a little stronger and say for ages, as the present system of lubrication is practically the same as it was when Joseph Rogers and Mathias Baldwin commenced building locomotives in America, which was in 1831 and 1835, respectively. We have depended on the action of the capillary attraction of wool waste to raise oil from the cellar to the journal. This is very good, but on long runs such as we have today this waste will settle or become so compact that the capillary attraction feature is, in a sense, destroyed. This is one thing that the mechanical department of railroads will have to take into consideration, on long locomotive runs.

The functioning of the waste-packed cellar is impaired on these long runs, to the extent that the proper lubrication of journals is unreliable and a substitute for oil must be found. Grease applied under slight, but constant pressure, is the remedy, something that will not be affected by long runs under various climatic conditions. It is not the amount of lubrication that is used on a journal bearing, but the fact that it is ever present and the journal is not allowed to run dry until heating starts, when oil lubrication becomes ineffective.

J. E. ALLEN.

The hot box problem—what about anti-friction bearings?

HAMMOND, Ind.

TO THE EDITOR:

A popular subject for discussion among various railroad clubs at the present time which has been a favorite subject in the years gone by is our old pal the Hot Box. The lubricating engineer of the A. B. C. railway reads a paper before the Podunk Carmen's Club. The paper is a good one and is thoroughly discussed. The author of the paper is given a rising vote of thanks and the members of the Podunk Carmen's Club "gird their loins" and go forth to do battle with their common enemy.

The expert in charge of lubrication on the X. Y. Z. railroad prepares and reads a paper before the Big Town Railway Club. Subject: "Hot boxes, their prevention and cure." He is given a vote of thanks, etc. Some of these papers are really well prepared and probably are understood by most of the club members. Others are technical, very technical indeed. It is doubtful sometimes if an occasional paper is understood even by the gentleman who prepared it.

In their efforts to find a method of overcoming the friction between the journal and bearing, so many gages to measure the bearings, keys, journals, boxes and dust guards have been designed that the journal box attendant would need considerable assistance if he tried to use them all. One expert says "don't do this," another says "don't do that," and after all is said and done they are only hoping for a reduction in delays caused by hot boxes. But, to paraphrase the song, "The little hot box on the railroad keeps burning the mileage away."

For many years no change has been made in the method used in affording lubrication to car journals. In a comparatively short time the capacity of the car has been doubled. The cry for speed and more speed is unceasing. The more weight and speed means more friction which in turn means more hot boxes.

This may be treason, but the writer wonders if the time isn't near when the old brass and packing method of the present will have to give may to modern roller or ball bearings? The initial cost would be high, but after viewing results in the motor industry, it might be the cheapest in the end.

H. R. RICE.

Cooling surface in the boiler furnace

PHILADELPHIA, Pa.

TO THE EDITOR:

In your May, 1926, issue, C. A. Seley takes exception to certain statements of mine published in the April issue, page 212, under the title, "Future Possibilities of the Locomotive Boiler." In so doing he introduces the subject of radiant vs. convection heat absorption, which has been agitating the engineering world this past year.

It seems agreed among stationary plant engineers that some water cooling surface in the boiler furnace promotes efficiency. They are still not agreed, however, despite Professor Christie's statements, on the limit to which such water cooling should extend. Thus Broido, one of the more recent writers on the subject, states in *Mechanical Engineering*, February, 1926, "The amount of water cooling surface that can be installed without lowering the furnace temperature to a point where combustion will be affected is dependent on the kind of coal used. Enough refractory, in other words firebrick, must be in the furnace, however, to reflect sufficient heat so that the temperature of the gases throughout the furnace is not lower than that required for combustion."

It must be remembered that stationary furnaces generally have greater combustion volumes than locomotive fireboxes, so that the water cooling surface has relatively less effect on the completion of combustion. It is not surprising then that stationary plant engineers should be

turning to the partial water cooling of their furnaces, who up till now have permitted so little of it.

After all is said and done, heat not absorbed by radiation in the firebox is not lost. It only increases the temperature of the firebox gases, thus aiding combustion. Increasing the temperature of the gases on entry to the tubes does not markedly increase the smokebox losses, since the tube evaporative efficiency per unit increases. Thus applying the formulas of Lawford Fry, it can be shown that gases entering a 20-ft. tube at 2,400 and 2,000 deg. respectively will show at the smokebox end but 25 deg. difference in temperature. It is thus evident that the amount of heat transfer in the firebox means comparatively little. Widely varying types of boilers show little real difference in their efficiency of heat transmission.

There are three kinds of efficiencies by which a boiler may be measured:

1—Efficiency of combustion.
2—Efficiency of heat transmission.
3—Efficiency of heat utilization.

The second or efficiency of heat transmission, is the type mentioned above.

The efficiency of combustion shows much chance for improvement. Nowadays locomotive boilers are designed to give their rated tractive force at 120 lb. of coal per sq. ft. of grate area per hour. Yet the actual heat utilized in evaporation is only about 55 per cent of the coal fired at such rates of burning, even though the heat transmission efficiencies be 75 or 80 per cent. This is due to the high unburnt fuel loss, averaging 25 per cent of all the coal fired at the 120-lb. firing rate, most of which goes up the stack as unburnt carbon or gathers as front end cinders and the like. It is evident then that the present type of locomotive and firebox is not keeping pace with the demands made on it.

The efficiency of utilization is another way of stating the ability to realize more mechanical work from the heat actually absorbed by the boiler. This finds its vehicle in the use of higher pressures, which are gaining more and more recognition from the engineering world every year. In two warships contemplated by the Government the use of 700 lb. préssure is being seriously considered, because of its possibilities in the saving of weight.

Sooner or later the writer feels that the staybolted locomotive firebox will have to go, and probably the firetube barrel as well, as neither is as well adapted as the watertube boiler to the higher pressures and improvements in combustion efficiency that the future is likely to demand.

We agree with Mr. Seley that the future locomotive will still be steam propelled in the majority of cases. There are some 260,000 miles of track and 60,000 locomotives in the United States today, a ratio of four to one. This ratio may decrease with time, but the building of branch lines in unsettled territory will tend to maintain it. It is inconceivable to think that financiers will go to the trouble of electrifying four miles of line for the debatable economies to be obtained from the electrifying of one locomotive. Heavily traveled routes, of course, may be electrified.

The Diesel engine's first cost is against its adoption now, and by the time this is reduced American oil supplies will be scarcer and oil more expensive than at present.

On the other hand we do not believe that the steam locomotive is going to stand still. It is not efficient now at rates of firing becoming common, nor do we feel that 200 lb. pressure is the last word of the next generation.

L. A. Rehfuss.

How far should engines be stripped?

Prescott, Arizona.

To the editor:

Your editorial in the August, 1926, *Railway Mechanical Engineer* on engine stripping, opens quite an interesting subject. Our experience with modern power when operated under an approved system of maintenance is that the extent to which engines should be stripped for general repairs should be governed entirely by conditions rather than by following any hard and fast rule. The determining conditions should be the age of the locomotive and the maintenance attention given it while in service.

When a locomotive needs general repairs it should certainly get all that the term implies and be turned out in condition to render any service it was ever capable of performing. It is a fact, however, that comparatively few locomotives shopped for general repairs need that thorough and minute inspection, necessitating a stripping to the ground which the term "general repairs" may be taken to mean.

Under a proper system of maintenance it is not practicable to run a locomotive until all the parts are worn so that general repairs of that character are required. The observance of federal rules as to limits of wear on machinery parts, boiler conditions and the life of flues, etc., has long ago corrected that practice where it was in effect. The reasonable requirements of service and economy of operation make it necessary to maintain certain vital parts of the locomotive in good condition at all times. Such maintenance work is strictly enginehouse or light repair work and the enginehouses are in position to keep them in as good condition as the back shop and should do so. If, for example, new bull rings and cylinder packing have recently been applied, piston rods turned, crossheads and guides alined, why should the back shop take on the expense of stripping these parts again if the engine is shopped for general repairs? It is questionable indeed if there is any economy in running locomotives until they need general repairs involving stripping them to the ground.

Modern heavy power used to its maximum making say, 12,000 miles per month in passenger service and 8,000 miles in freight service, develops conditions on tires, driving boxes, rods and other related foundation parts that require unwheeling every four to six months to keep them in first class condition. This can be done in from four to six days in a modern shop and by repeating that work and properly maintaining the lighter repairs and inspections in enginehouses, general repairs involving stripping off of all parts would be considered under three conditions only; namely, when engines have been wrecked; when they are getting old and approaching limits of wear or giving evidence of deterioration of material; or when held for heavy firebox or boiler work when the out of service time should be taken advantage of to inspect thoroughly and recondition all parts.

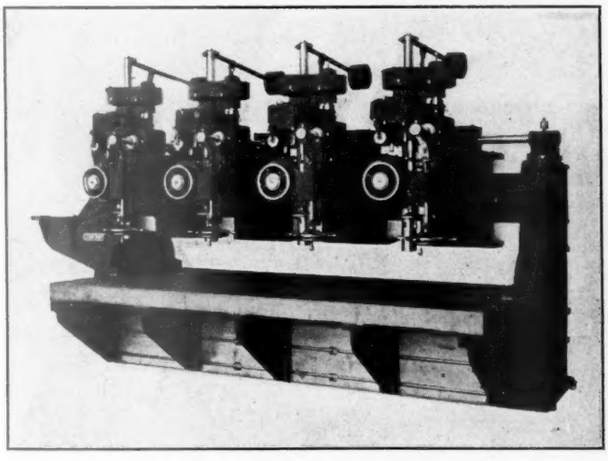
Charles Raitt,
Assistant master mechanic, Atchison, Topeka & Santa Fe.

Accident prevention.—"Accident Prevention on a Railroad" is the title of a booklet issued by the Metropolitan Life Insurance Company, 1 Madison avenue, New York. The report in this booklet contains the story of an accident-prevention survey carried out by the safety engineers of the Policyholders' Service Bureau for a Class I railroad—a group insurance policyholder of the Metropolitan Life Insurance Company. It illustrates the method used in making such a study and the type of information deemed essential.

Mud ring and flue sheet drilling machine

TO meet the demand of the railroad shops for heavier equipment required in the building of the modern type locomotive, the Foote-Burt Company, Cleveland, Ohio, has recently designed a drilling machine, which is called the No. 3 mud ring and flue sheet drilling machine, regularly equipped with four No. 30 heads. The long travel of the table, the back and forth, as well as the in and out adjustment of the spindles, allows the drilling of large flue sheets in one setting.

The spindles overhang the finished edge of the base so that mud rings can be bolted to this finished edge by

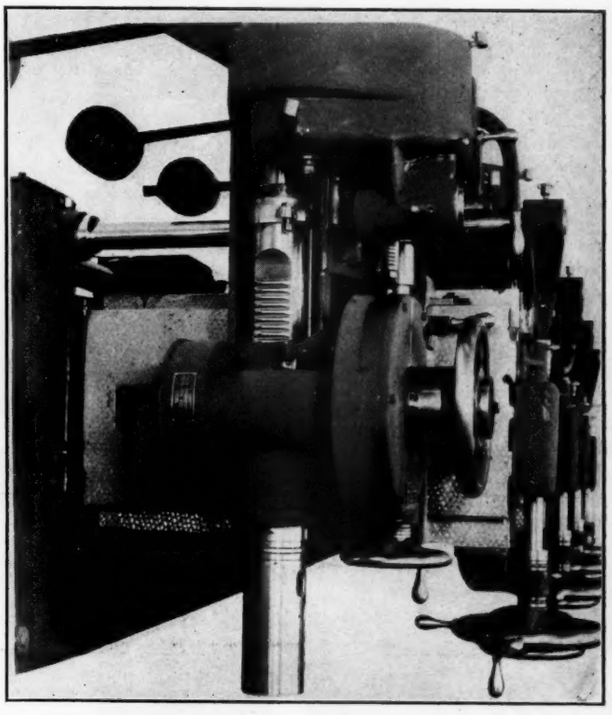


The Foote-Burt No. 3 mud ring and flue sheet drilling machine

means of three T slots running horizontally, for drilling the rivet holes. The two further outside knees that support the table are fixed, but the three center knees are adjustable in case they interfere with the clamping of mud rings. When drilling flue sheets all knees are securely doweled in position to form the bearing for the table.

This machine is so arranged that a pit can be placed in the floor flush with the front finished edge of the base to allow the mud rings to project down in it for drilling the rivet holes. The size of the pit is governed by the size of the mud ring.

The machine can be arranged for either belt or motor drive. The power is transmitted through a heavy horizontal shaft where the drive is taken for each head, through bevel gears. From there power is transmitted through a vertical shaft in each head through spur gears direct to the spindle. All gears subject to heavy duty



The head and spindle are of massive construction

are made of high grade steel and all shafts are mounted on bronze bearings.

Each head has a drilling capacity of 3½ in. in solid steel, or 7 in. using a flycutter. Each head is adjustable along the rail, the minimum center distance between the spindles being 24 in.; the maximum distance between the two outside spindles is 123 in. The spindles also have an in and out adjustment of 18 in. All hand wheels controlling the adjustments of the heads are located at the

front of the machine within easy reach of the operator. This also includes the hand wheel which controls the spindle itself. Each head is equipped with three quick feed changes independent of each other. The speed changes are accomplished by the cone pulley and back gears when the machine is arranged for belt drive, or by a variable speed motor when arranged for motor drive. The speeds in each head cannot be changed independently.

The spindles are made of high carbon steel and have long bronze bearings in the spindle sleeve. The spindle sleeve is also made of steel. The double rack is cut from the solid. This double rack feature is a "Foote-Burt" patent, and is said approximately to double the strength of the down pressure, which is enormous when large sized drills are used.

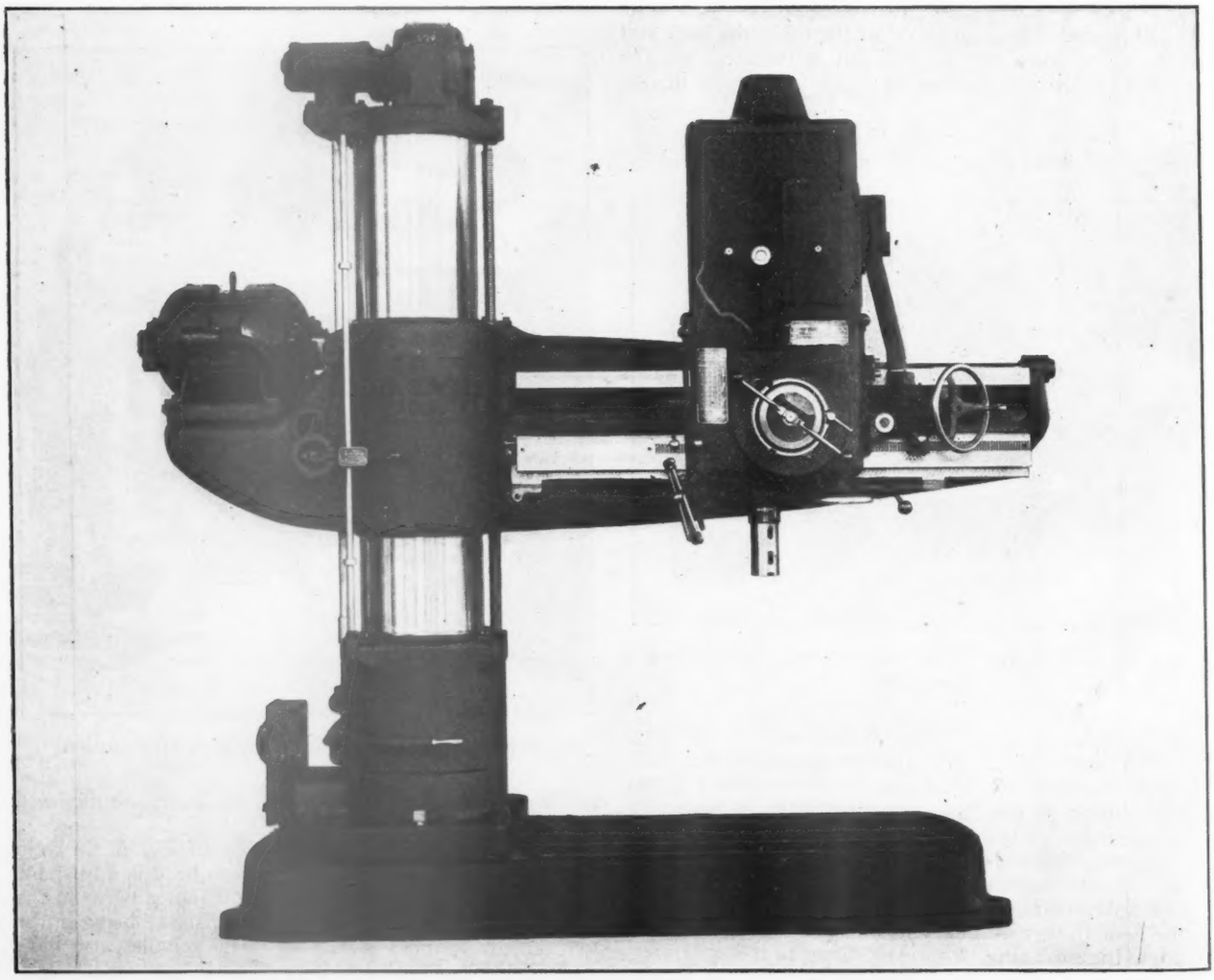
Great care has been taken in the design of this machine to make it as rigid as possible, the uprights being securely bolted to the base in an L-shaped pad. The cross rail carrying the heads is a box type and is placed in large slots in each of the uprights and securely bolted from three directions. Each head slide is wrapped completely around this box type cross rail and securely gibbed to obtain the maximum of bearing on the rail.

The table has a working surface of 75 in. by 144 in., and is provided with an in and out adjustment of 60 in. It should be placed at the extreme rear position when drilling mud rings.

The Cincinnati Bickford new radial drill

THE Cincinnati Bickford Tool Company, Cincinnati, Ohio, has just placed on the market an entirely new design of radial drill known as the Super Service drill. In the development of this machine, which is built in 5-ft. and 6-ft. sizes, the aim of the builders has been to speed up drilling time by reducing handling time. To accomplish this the design incorporates a 36-speed, 18-feed head in which all speeds are in the head; power rapid traverse; an easy swinging arm readily moved by the slight pressure of one hand; single lever arm control; power column clamping, either electric or pneumatic; and finally, all controls centralized so as to be accessible to the operator without moving away from his work.

In an effort to reduce maintenance to a minimum and insure long service the machine is built with Timken tapered roller bearings, automatic lubrication with Purolator oil filter system, multiple splined shafts with inte-

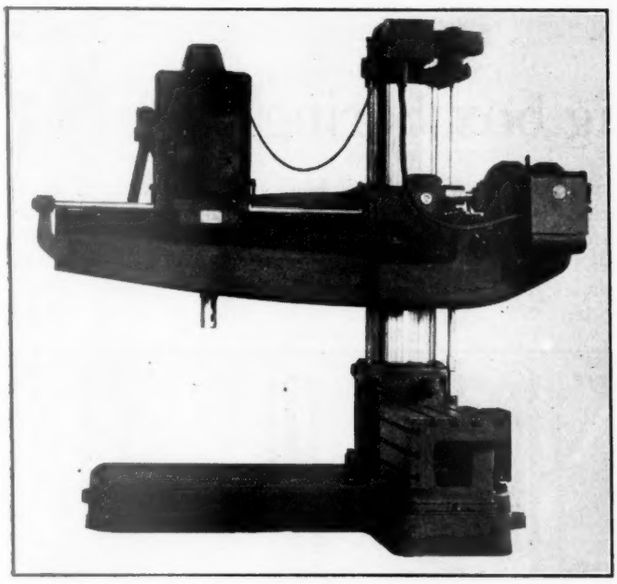


Front view of the 5-ft. super service radial drill, showing the arrangement of the controls

gral keys, all speeds and feeds through selective sliding gears, driving and feed change gears of heat treated alloy steel and square guideway mounting of the head on the arm. Safety features have been provided by the use of a patented safety nut to sustain the arm should the main elevating nut fail, a positive interlock to prevent elevation of the arm when clamped, a safety catch which prevents the spindle from dropping should the counterbalance chain break and the placing of the counterbalance inside the head.

The base is of box section throughout. Its entire area bears on the surface of the foundation. The top and bottom of the base are tied together by a system of heavy longitudinal and transverse ribs. These ribs, which are closely spaced, uniformly support the top of the base so that jack screws or other auxiliary supporting devices are not required. The weight of the column, arm and head, together with the work, is transmitted directly through these ribs to the foundation.

The column diameter is 17 in. The flange is double



Rear view of the new radial drill, showing the oil pump and Purolator—The air and electrical connections are carried up through the columns

thickness and the clamping surface has a large contact area. The construction of the lower part of the column, which permits of easy swinging of the arm, is distinctive. It consists of four large diameter, hardened steel rollers mounted on roller bearings. These rollers are built into the sleeve above the clamping surface and roll on a hardened and ground steel ring on the trunk.

Power column clamping, either air or electrically operated, is standard equipment. It enables the operator to clamp and unclamp the column without leaving his operating position at the head. This feature eliminates two round trips from the head to the column for every hole drilled. Air clamping is obtained through a double-acting air cylinder housed in the driving motor support. Electric clamping is obtained through a torque motor mounted on top of the column. Both the air cylinder and the motor are so located that they are not exposed to dirt and chips, nor are they in the operator's way. The hand clamping lever does not move when power clamping is employed.

The arm is massive, yet swings under the slight pressure of one hand. It is of patented, triple box section. The front and rear walls are tied together with heavy longitudinal ribs. All openings in the rear wall have been completely eliminated. The depth of the arm and the length of bearing on the column have been increased. A system of square lock gibs has replaced the dovetail mounting of the head on the arm. This provides a bearing which assures alignment in service. It prevents the rocking tendency of the head due to lack of adjustment of the main gib or the cutting action of the tool.

The entire raising and lowering mechanism is built into the arm as a complete unit, fully enclosed and automatically oiled by a system of flood lubrication. The old style rising and lowering mechanism on top of the column with its clash gears has been discarded. The screw is held stationary—the nut revolves. Friction clutches incorporated in the unit drive the nut in either direction. A patented safety nut sustains the arm and prevents it from dropping should any failure occur in the threads of the main nut. The safety nut gives immediate warning of the failure and the worn nut must be replaced before any further raising or lowering of the arm is possible.

A single lever clamps, unclamps, raises and lowers the arm. An equalized screw and lever action, applied at both ends of the arm cylinder, binds the arm tightly to the column. Greater leverage is provided for closing the upper end on account of the increased resistance at that point. A positive mechanical interlock prevents any engagement of the raising and lowering mechanism while the arm is clamped to the column. Safety stops prevent any movement beyond the upper and lower limits of travel.

Only one motor is required to drive the spindle, elevate the arm and operate the power rapid traverse. This motor is of the constant speed type for either direct or alternating current. Variable speed or multi-speed motors with their complicated control systems are not necessary. The motor support is of deep section and cast integral with the arm. The machine is completely wired. The wiring is run from the motor to the top of the column, down through the inside, and brought out through the rear of the base for connecting with an outlet in the floor. Piping for the air type column clamp is handled in a similar manner. Both have revolving connections in the lower part of the column which allow the arm to swing in a complete circle.

Thirty-six speeds and 18 feeds are incorporated in the head. The head is completely enclosed, includes power rapid traverse and contains the entire speed change mechanism. The entire driving mechanism—from motor to spindle nose—revolves in tapered roller bearings. They are completely sealed against the entrance of dirt and are automatically oiled. All shafts are multiple splined with integral keys. All driving gears and feed change gears are of carefully selected heat treated steels. All feed and speed change gears are of the selective sliding type. Tumbler gears and dive keys have been discontinued.

Power rapid traverse to the head is standard equipment. The constant speed arm shaft has been utilized as a source of power which reduces the rapid traverse to a relatively simple mechanical device. The head moving handwheel does not revolve when the power rapid traverse is engaged.

All of the 36 speed changes are in the head. They are obtainable through selective, sliding gears by the use of only three levers. They have a 60 to 1 range with a maximum of 1,415 r.p.m. They are closely enough graded that a speed can be selected which will drive a drill up to the limit of its working capacity.

The machine can be furnished with any one of five intake speeds which provide the following minimum and maximum spindle speeds—15 and 912, 16 and 1,004, 18 and 1,124, 21 and 1,278, 23 and 1,415 r.p.m.

Eighteen feed changes are obtained through selective, sliding gears by the use of only two levers. The feeds range from .006 in. to .125 in. per revolution of the spindle and include tap leads for 8, 11½ and 14-thread pipe taps. The tap leads relieve the operator of the exertion required to start pipe taps and eliminate the possibility of thin threads. A compensating depth gage not only drills to a prescribed depth but also compensates for the length of the drill point. This feature assures for accuracy.

The spindle has six splines insuring minimum feeding resitance under heavy torsional loads. This is of extreme importance on heavy tapping for it eliminates the danger of thin threads. The spindle sleeve and feed rack pinion are of special alloy steel having an ultimate tensile strength of more than 200,000 lb. per sq. in. The feed rack is integral with the spindle sleeve. The spindle revolves in roller bearings packed in grease which eliminates indifferent spindle oiling and the resultant damage to bearings.

The spindle is counterbalanced at all positions by a flat, coiled spring of unusual capacity. A patented cam arrangement compensates for the varying tension of the spring. The tension can be quickly adjusted to provide additional counterbalancing for heavy cutter bars, etc. A patented safety grip prevents the spindle from dropping should the counterbalance chain break. The entire counterbalance mechanism is enclosed in the head.

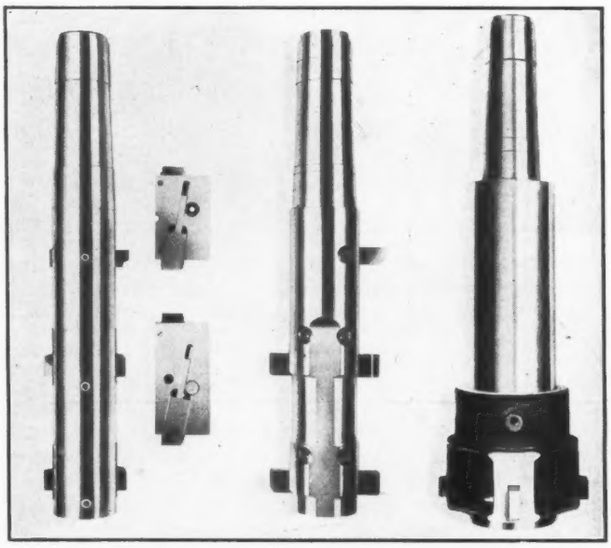
Lubrication has been so designed that the machine operates over a long period without oiling. The entire head is automatically oiled. A submerged pump forces oil through a Purolater filter to the top of the head where it cascades down through all gears and bearings. The friction clutches run in oil. A high pressure grease system lubricates the roller bearing spindle. A large reservoir with wicks and copper tubing oils the gibs and all surfaces of the head which bear on the arm. The arm raising and lowering unit and the motor driving gears run in oil. The arm shaft outer bearing is packed in grease.

Car wheel and driving box boring tools

THE Kelly Reamer Company, Cleveland, Ohio, has placed on the market several types of recently developed tools particularly adapted to car wheel and driving box boring work. In the design of these tools the manufacturer has recognized the fact that railroad shop work is not primarily of the large production nature and that it is necessary to accomodate tools to the handling of a large number of miscellaneous sizes. In addition to this, these new tools have been designed with the idea of simplifying the process of changing tools for different sizes of work. The illustration shows three types of boring tools—two of which are especially adapted to boring car wheels and the third for driving box work. Of the two car wheel boring bars one is of the expansion type and the other a special design using block unit tools. By the use of the block unit tools it is possible to bore a complete range of sizes with one bar and the different block units making it possible to effect a considerable saving of time by eliminating the necessity of changing and realining the complete bar.

As may be seen from the illustration, the support bar may be set up, alined and keyed in position. It is not necessary to remove the bar from the machine because of the fact that it accommodates several sizes of block units which can be quickly interchanged in the bar for different size bores. When the larger sizes are encountered a support head is slipped on the bar which supports the block unit close to the cutting points, giving added strength to the tool without the inconvenience and loss of time occasioned by changing the bar in the machine. This latter type of tool is particularly adapted to the boring of driving boxes and side rods.

The construction of the block unit is particularly heavy to withstand the shocks to which they will be subjected. The blades are made of special analysis high speed steel of heavy cross section so as to present ample cutting face and to dissipate readily the heat of heavy cuts. Adjustment of the blades is secured in or out by means of a rack which engages a pinion. This pinion is integral with a worm wheel which engages the worm. As the worm wheels of both blades are driven by the same worm, both blades can be adjusted accurately in or out simultaneously. This construction has been used with the idea of preventing any change in blade adjustment due to the thrust action upon the blades. In addition to this, however, each blade is provided with an individual lock. The car wheel boring

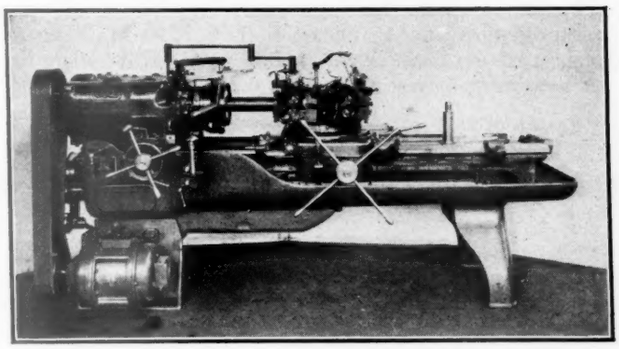


Beginning at the left bar No. 1 shows the block unit car-wheel boring tool—Bar No. 2 represents the expansion car wheel boring tool—Bar No. 3 shows the driving box boring tool assembled with the support head and block type cutter in place

tools are designed to handle a range of bores from 5½ in. through and including 9 in. The side rod boring tool is designed to handle bores from 5½ in. through 11½ in. and with the use of the support head from 11¼ in. through 14 in. The driving box boring tool will handle with the open bar, bores from 8 in. through 11½ in., and with the support head from 11½ in. through 14 in.

Hartness 4-in. by 34-in. flat turret lathes

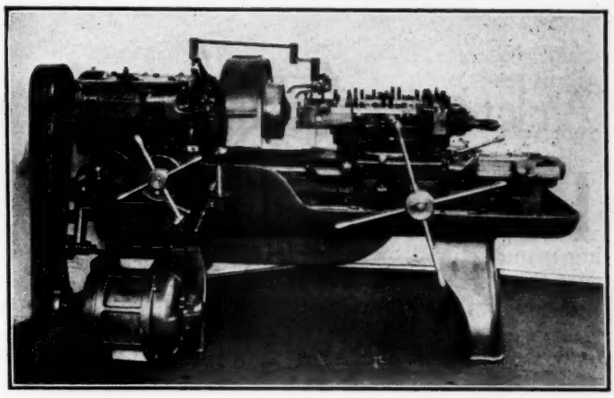
A 4-IN. BY 34-IN. Hartness flat turret lathe, made both as a bar machine and as a chucking lathe has recently been placed on the market by the Jones & Lamson Machine Company, Springfield, Vt. The capacity of the machine for bar work is 4 in. in diameter by 34 in. in length. The chucking lathe is equipped with a 17-in. chuck and has a swing of 21 in. on centers and a swing over the ways of 17½ in.



The Hartness bar turret lathe

The headstock has been redesigned, not only to add to the spindle capacity, but also to the rigidity and pulling power of the lathe. The spindle is 5¼ in. in diameter with a hole $4\frac{3}{16}$ in. in diameter. It is mounted in large split bronze bearings. The shafts are made of heat treated alloy steel and mounted in ball bearings. The change speeds, forward and reverse, are effected through multiple disc clutches. These clutches, shafts and gears are sufficient in strength to pull any work within the capacity of the machine and to insure the positiveness of rotation equal to the cuts in the 17-in. chucking lathe.

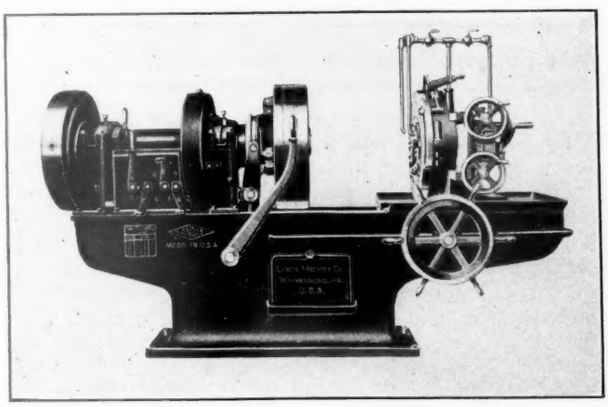
The bar outfit is similar to that of other Jones & Lamson flat turret lathes. The 17-in. chucking lathe is equipped with a square turret. Simple multiple tooling on large diameter chuck work is made possible by the large square turret and the cross sliding headstock. The tooling of the 17-in. chucking machine is also similar to the tooling of the other Jones & Lamson chucking machines. The inexpensive standard tooling is sufficient for the majority of chucking work and special tools are seldom required.



The Hartness motor driven 4 in. by 32 in. flat turret chucking lathe set up to machine a piston valve head

Four-inch pipe threader and cutter

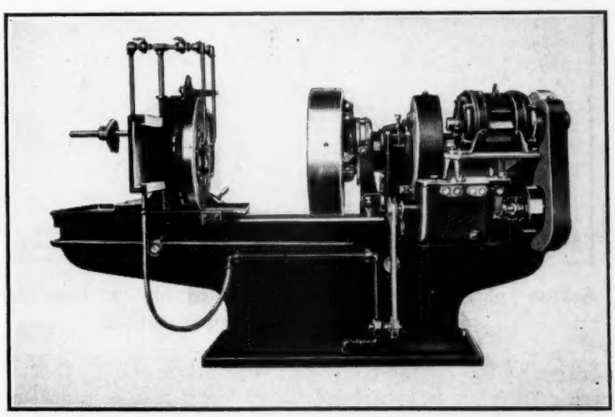
THE Landis Machine Company, Waynesboro, Pa., has added to its line of pipe threading and cutting-off machines a 4 in. size which has a base of different design from the other sizes. The new outline of the bed offers ample support for the headstock and carriage.



The operating levers are conveniently located

The machine has a gear box and a single pulley drive, and is readily converted to motor drive. All gears are cut from steel and run in an oil bath. A reversing mechanism contained in the gear box is operated by a lever. This reversing mechanism eliminates the necessity of crossing the belt or throwing a switch when the machine is to be reversed.

The front and rear chucks are of the three-jaw type.



Rear view of the Landis 4-in. pipe threading and cutting off machine showing the location of the gear box and motor

The front chuck, which has a universal adjustment is lever operated, thereby permitting the pipe to be put in and taken out of the machine without stopping. The

rear chuck has an independent adjustment. The main spindle of the machine is supported by two distinct bearings which are lubricated by flat link chains running in an oil reservoir.

The carriage supports the cross rail, on which is located the die heads, the centering jaws, the cutting off tools and the reaming tool. Two cutting off tools are employed and are located diametrically opposite each other in holders which have a universal movement to and from the center. These holders also have a horizontal adjustment for centering the tools. The reaming device is attached to the cutting-off tool slide and is lever operated.

The range of the machine is from 1 in. to 4 in. This range is covered by two Landis stationary pipe die heads, namely a 2 in. head for a range from 1 in to 2 in. and a 4 in. head for a range from 2½ in. to 4 in. The die heads float in a T-slide on the cross rail.

All starting, stopping and reversing levers are located on the operating side of the machine within convenient reach of the operator, as are also the levers for obtaining the various speeds. The machine has eight speeds. The travel of the carriage is 24 in. The floor space required is 4 ft. 5¼ in. by 8 ft. 6 1/16 in. The net weight of the belt-driven machine is 5,700 lb. while that of the motor-driven machine is 6,300 lb.

Arktite circuit-breaking plugs and receptacles

PLUGS and receptacles embodying a principle which meets the demand for circuit-breaking devices in capacities heretofore considered impractical are being manufactured by the Crouse-Hinds Company, Syracuse, N. Y.

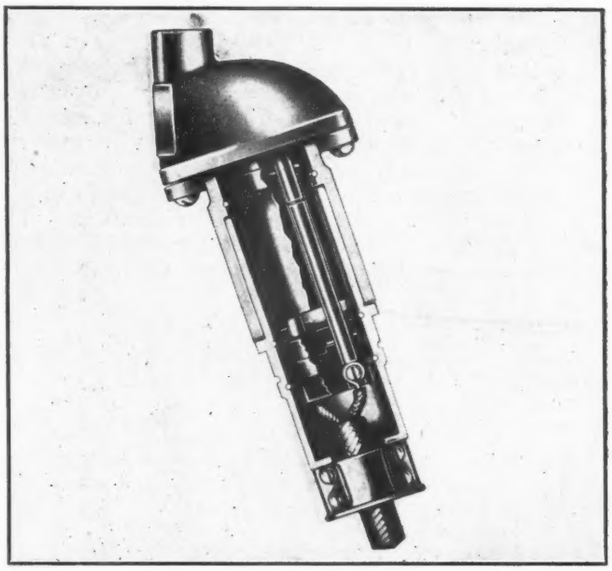
As the name implies, the arc formed by pulling the plug is so completely confined in a chamber of insulating material that it is impossible to form a short circuit or ground. The air and gases confined in the chamber expand rapidly and smother the arc.

Portable devices can be thoroughly grounded through Arktite plugs and receptacles. Where it is permitted to use a ground wire having a current capacity less than that of the circuit wires, the cable connected to the plug must have an extra conductor for grounding, and one end of the extra conductor must be connected to the

Arktite plug and receptacle mounted on a type Qee condulet, showing the detent spring

frame of the portable device. The other end of this extra conductor is bent back, threaded through a slot and connected to a grounding screw on the outside of the plug handle. The ground connection is completed through the detent springs in the receptacle, when the plug is inserted. This method conforms to the requirements of the National Electrical Code.

Where it is required to use a ground wire having a current capacity equal to that of the circuit wires. The cable connected to the plug must have an extra conductor for grounding and the plug and receptacle must have an extra pole to which the grounding conductor is connected. Therefore, where it is desired to ground the frame of a portable device in this manner, it will be necessary to use a three-pole plug and a receptacle for



Arktite plug and receptacle mounted on a type Qee condulet, with the plug partially inserted

a two-wire circuit and a four-pole plug and receptacle for a three-wire circuit. To complete the grounding connection on the receptacle, either a grounding ring is clamped between the receptacle housing and the condulet, or a flexible cable is connected to the soldering lug on the inside of the condulet. One end of the extra conductor is connected to the frame of the portable device, and the other end must be connected to the extra pole in the plug. The grounding connection is completed when the plug is inserted in the receptacle.

Arktite plugs and receptacles are simple in construction. The contact members in the receptacle are fingers and those in the plugs are tubes, each of a single piece of special alloy brass machined to an accurate fit. The receptacle fingers are slotted and opened slightly to insure a good contact. The plug tubes fit very closely into chambers of insulating material in the receptacle when the plug is inserted, and the circuit wires are connected directly to the ends of the contact members, eliminating

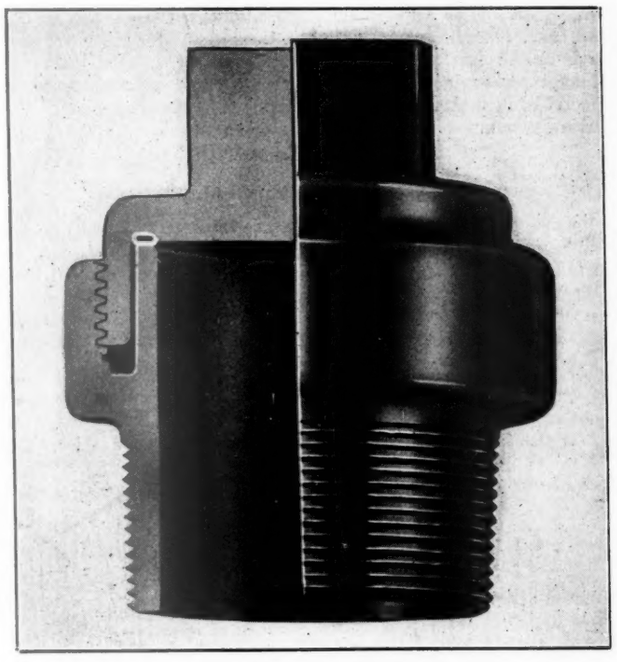
all lugs. The insulating parts of both the plug and receptacle contain separate chambers for each pole, in which the arcs are broken.

No screws are used in assembling the interior parts of the plug and receptacle. All parts are held in position by phosphor bronze retaining rings, which seat in grooves and cannot be dislodged by vibration or strain. To wire the plug the phosphor bronze retaining ring is removed by inserting a screw driver a quarter turn. The retaining ring will then spring out of its groove, and can readily be removed, permitting the withdrawal of the interior parts. The receptacle is wired in a similar manner.

These plugs and receptacles are made in 10, 30, 60, 100 and 200 amperes; 250 volts a. c. or d. c., 600 volts a. c.; and two, three and four poles.

Safety washout plugs with Acme threads

THE Housley Flue Connection Corporation, Indianapolis, Ind., has recently placed a safety type of washout and arch tube plugs on the market which represent a distinct departure from conventional design. The fundamental idea of the Housley plug is to provide a safe arrangement whereby the threads in the boiler sheets are protected from injury and at the same time allow better inspection and more thorough cleaning during the washout operation. This idea has been put into practice by making the plug in two parts—one part remaining permanently in the boiler sheet and the entire unit being made of forged steel.



When no threads are visible on the cap of this plug it is an indication that the cap is properly seated on the gasket

The details of construction are plainly shown in the illustration. The sleeve or body of the plug is threaded with standard boiler threads for fitting into the sheet. The thread by which the cap is joined to the sleeve is known as the Acme thread, the pitch being nine threads per inch. The joint between the sleeve and cap is sealed by means of a graphited copper-asbestos gasket which fits tightly into a cavity in the cap and will not drop out when the cap is unscrewed. The dimensions of the plug and sleeve are such that the cap must be seated to a sufficient depth so that no threads will show, which is an indication that the cap is properly seated on the gasket.

The method of applying the Housley washout plug is simple. The hole in the sheet is reamed and tapped according to the standards of the individual road. The sleeve of the plug is then screwed into the sheet until the fit is steam-tight, after which the inner edge is rolled over the sheet. The cap is then screwed down until the joint between the cap and sleeve is sealed by the copper-asbestos gasket. When the cap is seated, its threads are completely covered by the projecting lip of the sleeve. The sleeve is fastened doubly and permanently steam-tight in the sheet by rolling the thread-fit. The Acme thread connecting cap and sleeve has unusual strength and makes cross-threading of the cap and sleeve impossible. This thread, together with the copper gasket, makes the joint between sleeve and cap secure, yet the cap may be easily tightened or loosened.

Larger holes and clear passages for free washing are other advantages. It will be noted that the holes through which washout nozzles are inserted have no threads so that the washout men can work the nozzles in all directions without the fear that they will damage the threads in the hole. The large openings through the 2⅞-in. plugs on the four corners of the mud-ring and in the barrel of the boiler allow a greater outflow of water which affords a faster and cleaner washout.

Brass flexible pipe joint

SIMPLICITY of construction is the predominant feature of a comparatively new type of flexible joint known as the Flexo which is made by the Flexo Supply Company, St. Louis, Mo. There are no ground parts or springs in the Flexo joints, nor is packing required. A formed, resilient seal is mechanically compressed between two machined surfaces. The pressure of the fluid in passing through the fitting inflates the seal, which with the mechanical compression makes a tight joint at all times, but one that can be easily moved.

These joints are of all-brass construction and their patented design is said to insure a full and uninterrupted flow irrespective of the angle to which the joint is swung. Flexo joints may be used for conveying steam, compressed air, water, oil, or practically any fluid that has no deteriorating effect upon brass. They are furnished in all sizes from ¼-in. to 3 in. with standard female threads.

ENGINE INDICATORS.—The design and construction of the Maihak engine indicator, its parts and accessories, also the Maihak automatic power integrator, are clearly described and illustrated in Bulletin No. 261 which has been issued by the Bacharach Industrial Equipment Company, 7000 Bennett street, Pittsburgh, Pa. The automatic power integrator is designed to correctly measure mean indicated horsepower over any period of time for any steam engine, regardless of variation of load, and for any oil engine, regardless of any change within the engine cylinder.

News of the Month

The Missouri Pacific and the Denver & Rio Grande Western have consolidated their engine shops and freights yards at Pueblo, Colo.

The Enginemen's School of Instruction on the Wabash will be extended to its subsidiary, the Ann Arbor, in the near future. The school instructs firemen in the economical handling of fuel and enginemen in train handling.

The Pullman Company will add 200,000 sq. ft. of floor space to its Calumet, Ill., repair shops, at a cost of approximately $1,250,000. Plants, office buildings, laundry and oil houses will be enlarged through the construction of several small buildings and additions. Electrical equipment and other machinery will be purchased.

H. E. Byram, receiver, in an address before a meeting of employees of the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., on August 23, commended the employees for the response they had made in the last 18 months to the demand for greater economy and increased efficiency. During this period the net tons per train increased from 511 to 680, or approximately 33 per cent, the gross tons per train increased from 1196 to 1523 or 27.3 per cent, and the average load per car from 20.67 tons to 26.35 tons or 22.7 per cent. The consumption of fuel per thousand gross ton miles decreased from 204.2 lb. to 171.6 lb. or 16 per cent.

The Law of New York (known as the Kaufman Act) under which all railroads operating within the limits of New York City are required to discontinue the use of steam locomotives, has been declared unconstitutional in a decision handed down last week by Federal Judges Learned Hand, John C. Knox, and Thomas D. Thacher. The larger roads had already secured an injunction deferring the enforcement of the law. The court holds that the law would be a regulation of interstate commerce, interfering with the proper exercise of such regulation by the federal government. The regulation of locomotives is a field in which Congress has already acted—in the boiler inspection act and in parts of the safety appliance acts.

Musical locomotive whistles on the St. Paul

The Chicago, Milwaukee & St. Paul has had in service for some time on the locomotives of the Southwest Limited, between Chicago and Kansas City, a chime whistle which has proved so satisfactory that it is planned to introduce it for general use. A circular issued by H. E. Byram, receiver, telling of the action of the company in this matter, starts off with verse:

> Casey pulled up that Reno hill
> and tooted for the crossing with an awful shrill.

Continuing, the circular says:

"The immortal Casey Jones, according to the famous song of a decade ago, has 'gone to the Promised Land with his orders in his hand.' But the sudden and lamented departure of that brave engineer did nothing to abate a nuisance that has set millions of teeth on edge and caused the cold shivers to ripple up and down countless spinal columns. Thousands of Casey Jones' compatriots have carried on where he left off and have been 'tooting for the crossing with an awful shrill.' The raucous shriek of locomotive whistles has made night hideous for millions. Needlessly, it seems.

"The Chicago, Milwaukee & St. Paul Railway, after a series of tests, is installing on its engines a new chime whistle which, according to its designer, L. K. Sillcox, is as 'soft as the woodwinds of a symphony orchestra.' It has a baritone mellowness that not even a saxophone can surpass.

"After the new musical whistle was installed on the Southwest Limited, between Chicago and Kansas City, so many communications were received regarding it from passengers and residents along the line that its general use over the C. M. & St. P. system has been approved. Officers of the road are satisfied that the new 'bassoon whistle,' while extremely soft and pleasing to the ear, carries fully as far as the rasping screech of the older type."

Wage statistics for June

The Interstate Commerce Commission's summary of reports of wage statistics filed by Class I steam roads shows a total of 1,833,621 employees as of the middle of June, 1926, an increase of 24,893, or 1.4 per cent over the number for the previous month. The total compensation $249,055,495 shows an increase of $2,518,261, or 1.0 per cent. The number of employees reported in June, 1926, in comparison with the returns for the corresponding month last year, shows an increase of 2.9 per cent. The compensation increased 3.8 per cent. The greater percentage increase in compensation is due principally to an increase in the average number of hours worked per employee.

New equipment

The Chicago & North Western has authorized the purchase of 100 steel coaches, 20 steel combination baggage and smoking cars, 10, 70-ft. steel baggage cars, and three, 70-ft. combination baggage and smoking cars. The rebuilding of 35 steel passenger cars also has been authorized. This company has ordered two baggage and dormitory cars from the American Car & Foundry Company.

The New York Central has placed orders for 124 cars for passenger service as follows:

New York Central.	10 coaches	Pullman Car & Mfg. Corp.
	3 passenger and baggage.	Amer. Car & Foundry Co.
	30 suburban coaches.....	Osgood-Bradley Car Co.
	2 suburban passenger and baggage.	Osgood-Bradley Car Co.
	2 suburban pass., bagg. and mail.	Osgood-Bradley Car Co.
	20 milk	Merchants Despatch, Inc.
Michigan Central.	10 coaches	Pullman Car & Mfg. Corp.
	10 baggage 69 ft. 3 in.	Amer. Car & Foundry Co.
Boston & Albany.	10 coaches	Pullman Car & Mfg. Corp.
	2 passenger and baggage.	Amer. Car & Foundry Co.
	10 baggage 60 ft. 6 in.	Amer. Car & Foundry Co.
Pittsburgh & Lake Erie	10 coaches	Amer. Car & Foundry Co.
	5 baggage and mail...	Amer. Car & Foundry Co.

Fuel statistics

Class I railroads consumed 49,935,063 net tons of coal and 990,537,707 gallons of oil as fuel for road locomotives in the first six months of 1926, according to the Interstate Commerce Commission's monthly compilation of railroad fuel statistics. This compares with 47,404,406 tons of coal and 982,053,985 gallons of oil in the corresponding period of last year. The figures apply only to fuel charged to operating expenses and do not include switching service.

Although more fuel was consumed than in the first six months of last year the total cost was less; $160,076,809 as compared with $162,962,196. The average cost of coal per ton decreased from $2.78 to $2.63 while the average cost of oil decreased from 3.17 cents per gallon to 2.91 cents. The cost of the coal used was $131,291,648 and the cost of the oil was $28,785,161.

For the month of June the average cost of coal was $2.61 as compared with $2.70 last June and the average cost of oil was 2.92 cents as compared with 3.30 cents last June. For the month of June alone the total cost of coal and oil was $24,247,192.

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATMENT.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27-30, Chicago.

BIRMINGHAM CAR FOREMEN AND CAR INSPECTORS' ASSOCIATION.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting second and Monday in each month at Birmingham Y. M. C. A. Building. Next meeting October 11.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting October 12, 8:30 p. m. Paper on the fuel problem of Canada will be presented by Leslie R. Thomson, consulting engineer, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Annual meeting Oct. 11, Morrison Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis. Next meeting October 12, at 8 p. m. Paper on A. R. A. billing will be presented by Z. F. Mitchell of the St. Louis-Southwestern.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 811 Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting Nov. 9, Hotel Gibson, Cincinnati.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting October 4. R. V. Wright, editor of the *Railway Mechanical Engineer*, will present a paper on improving the standards of supervision.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capital Ave., Omaha, Neb.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting October 5. Percy Todd, president, Bangor & Aroostook, will be the speaker.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August at 29 West Thirty-ninth St., New York. Next meeting October 15. N. C. Miller, director, Rutgers University, New Brunswick, N. J., will present a paper touching upon the foreman training problem.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—A. S. Sternberg, Belt Railway Clearing Station, Chicago.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting November 18, Ansley Hotel, Atlanta.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway Shops, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month Terminal Hotel Bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 W. Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The Oakley Chemical Company, New York City, has changed its name to Oakite Products, Inc.

William C. Bergman, president of the Parsons Company, Newton, Iowa, died on August 23.

The Wayne Tank & Pump Company, Fort Wayne, Ind., is preparing plans for a two-story plant, 62 ft. by 86 ft.

R. H. Rich has been appointed advertising manager of the Cleveland Automatic Machine Company, Cleveland, Ohio.

James H. Watters, assistant to the president of the New York Air Brake Company, New York, has been elected a vice-president.

Lauren J. Drake, president of the Galena Signal Oil Company, has been elected president of the Union Tank Car Company, with headquarters at Chicago, to succeed E. C. Sicardi, retired. H. E. Felton remains chairman of the board of directors. Lauren J. Drake was born at Keokuk, Iowa, on August 27, 1880. After attending public schools in Omaha, Neb., and Chicago, Ill., he became a student at the Shattuck Military School, Faribault, Minn., graduating in 1899. Mr. Drake then entered the oil business, acquiring by service with several important oil companies, a general and broad knowledge of the business in all its branches, specializing in the marketing end of the business. In 1905, he went to the Galena Signal Oil Company as a representative in the middle west and served until 1916, when he went to its executive offices in New York as vice-president and director of the company. On February 24, 1920, Mr. Drake was elected president of the Galena Signal Oil Company, with headquarters at New York.

L. J. Drake

Walter Hallen, with offices at 30 Church street, New York, has been appointed representative in that territory of the Wooding Forge & Tool Company, Verona, Pa.

Henry Robbins Wardell, a director and consultant on roofing and waterproofing material for Johns-Manville, Inc., New York, died on September 13 at Loon Lake, N. Y.

Bruce Owens, sales manager of the Magnus Company, Inc., with headquarters at Chicago, has resigned to become vice-president of the O'Malley Beare Valve Corporation, Chicago.

John R. Blair, of the sales department of the Pittsburgh Steel Products Company, Pittsburgh, Pa., has been appointed manager of sales, to succeed Charles F. Palmer, who has resigned.

Ralph J. Stayman, district sales manager in charge of the warehouse at Chicago for the Jones & Laughlin Steel Corporation, has been promoted to general manager of warehouses, a newly created position.

C. W. Sullivan has been appointed western representative of Leslie Company, with headquarters at 565 West Washington Boulevard, Chicago, succeeding J. J. Cizek, who has been appointed vice-president, with headquarters at Lyndhurst, N. J.

The Logan Iron & Steel Co., Philadelphia, has appointed J. T. Stephenson, who has headquarters in the Munsey building at Washington, D. C., as its selling agent for the territory from Baltimore, Md., south to Atlanta, Ga., and Wilmington, N. C.

B. M. Cheney, president of Laughlin & Cheney, Inc., Chicago, sales agents for the Verona Tool Works, Pittsburgh, Pa., and other companies, has been appointed district sales manager of the Verona Company, with headquarters at Chicago, and the firm of Laughlin & Cheney, Inc., has been dissolved.

R. C. Simmons, formerly manager of the Seattle district of Johns-Manville, Incorporated, has been transferred to the New England territory, handling the railroad and the United States Government work. Mr. Simmons is associated with C. D. Folsom, of Johns-Manville, Incorporated, at 55 High street, Boston, Mass.

H. E. Graham has been appointed an assistant vice-president of the American Car & Foundry Company and will be associated with the sales department at New York. Mr. Graham was formerly connected with the Pressed Steel Car Company and later was vice-president in charge of sales of the Standard Tank Car Company.

Col. Leonard S. Horner has resigned as vice-president and manager of sales of the Acme Wire Company, New Haven, Conn., and has been elected president of the Niles-Bement-Pond Company, New York, succeeding James K. Cullen who has resigned to devote his entire time to his activities as president and general manager of the Niles Tool Works. Colonel Horner was born at Marshall, Va., on March 26, 1875. He attended the Bethel Military Academy and is a graduate in electrical engineering of Lehigh University, class of 1898. After his graduation he was employed by the American Telephone & Telegraph Company as construction engineer and was later electrical engineer and sales manager of the Crocker-Wheeler Company. He is now a director of the Crocker-Wheeler Company, the Acme Wire Company, and the Pratt & Whitney Aircraft Company of Hartford, Conn.; vice-president of the New Haven Chamber of Commerce; a counsellor of the United States Chamber of Commerce, and a member of the Board of Aviation. He served in the Spanish-American War with Troop A, New York Cavalry. During the World War he enlisted in the Signal Corps, Air Service Division, being commissioned major and put in charge of the manufacturing facilities and production of Liberty engines, airplanes, airplane machine guns and other airplane accessories. After serving in this capacity for eight months, he became a lieutenant-colonel and chief of staff to the commanding officer of Aircraft production. Colonel Horner's efforts in the production of Liberty motors and airplanes resulted in his being cited by the British Government for meritorious service.

Col. L. S. Horner

Harry Keith Mask, assistant to the vice-president of the Nathan Manufacturing Company, New York, and at one time assistant road foreman of the Maryland division of the Pennsylvania, died at the home of his sister in Wilmington, Del., on August 31, 1926. Mr. Mask was born in Cecil county, Maryland, but spent a greater part of his life in Wilmington until, 20 years ago, he moved to New York.

The Pyrotung Manufacturing Company has been organized recently and a new plant built at 730 W. 50th street, Chicago, for the manufacture of railroad track drills and shop cutting tools. These tools are made by the new Pyrotung process, designed to give unusual toughness and hardness without brittleness. The officers of the new company are: W. R. Otis, president; C. E. Sutten, vice-president; B. C. Cleveland, vice-president and metallurgical engineer, and C. E. Pynchon, general manager, formerly manager of the machinery and tool departments of J. T. Ryerson & Son, Inc.

Trade Publications

Motors.—The General Electric Company, Schenectady, N. Y., has issued two bulletins descriptive of its Type CO-1820 direct-current crane and hoist motors and its "900 series" wound rotor induction motors.

Pipe failures.—Extracts from a committee report of the Air Brake Association are incorporated in a pamphlet entitled "Pipe failures in railway service," which has been prepared by the A. M. Byers Company, Pittsburgh, Pa.

I-Beam trolleys.—The Northern Engineering Works, 210 Chene street, Detroit, Mich., has issued an eight-page bulletin describing in detail the construction of its all-steel I-beam trolleys equipped with Hyatt roller bearings.

Tool steel handbook.—The Ludlum Steel Company, Watervliet, N. Y., has issued the second edition of its tool steel handbook, describing in detail carbon, alloy, rust and heat treating steels; their use; methods of treating, etc.

Drop pit table.—The construction and operation of the Whiting electric drop pit table for locomotive and car shops, its advantages and savings, are described in Catalogue No. 177 issued by the Whiting Corporation, Harvey, Ill.

Gairing tools.—Catalogue No. 19 describing its complete line of tools, which include counterbores, spotfacers, core drills, etc., has been issued by the Gairing Tool Company, Detroit, Mich. Price lists also are included in this 78-page, illustrated catalogue.

Pipe threading.—The new Red-E-Hall portable pipe threader is described and illustrated in a 12-page catalogue which has been issued by Hall-Will, Inc., Erie, Pa. This machine is adaptable for use in industrial plants, railroad shops, electrical power stations, etc.

Traveling grate stoker.—The construction and operation of the Coxe stoker for boilers from 150 hp. up are described and illustrated in Catalogue C-4 which has been issued by the Combustion Engineering Corporation, 43 Broad street, New York. This stoker is designed to burn a wide range of fuels, especially small sizes of anthracite coal and coke breeze.

Pipe tools and machines.—A complete catalogue, List No. 35, including such new additions to the Oster line as the quick acting vise and the special type reamer and single wheel cutter for use with mechanical drives, has been issued by the Oster Manufacturing Company, Cleveland, Ohio. The catalogue contains 48 illustrated pages, and a thumb index is provided.

Die heads.—"18 vital questions to ask when selecting a die head" is the title of an interesting publication which has been prepared by the Eastern Machine Screw Corporation, New Haven, Conn. The questions are ones which any purchasing agent, superintendent, master mechanic, foreman or operator should ask when considering the selection of self-opening die heads. Tables in this booklet show the principal dimensions of H. & G. die heads.

Plug Valves.—The Merco Nordstrom Valve Company, 121 Second street, San Francisco, Cal., has issued Catalogue No. 5 descriptive of its straight way, three way, and four way plug valves and Merco Nordstrom wrenches for plug valves. These plug valves are made of semi-steel, all iron, cast steel, mercoloy, bronze, or aluminum, and are provided with lubricants adapted to all kinds of service. The lubricants are prepared in cartridge form.

Electric equipment.—Complete information on locomotive headlight mountings and recommended wiring for locomotive lighting, etc., together with tables, diagrams and material lists, is presented in the third edition of catalogue No. 101 which has been completed by the Pyle-National Company, 1334 North Kostner avenue, Chicago. A number of recent developments in locomotive headlight case construction are described in this edition, which includes also data on the Pyle-National line of turbo-generators and yard floodlights and a representative selection of the Oliver wiring appliances for locomotive, car and shop wiring.

Personal Mention

General

G. G. RITCHIE has been appointed chief fuel inspector of the Chesapeake & Ohio, with headquarters at Richmond, Va., succeeding S. Hernaman, retired.

R. M. BROWN, assistant superintendent of motive power of the New York Central at New York, has been appointed superintendent of motive power, with the same headquarters.

E. L. KERLIN has been appointed traveling engineer of the Wisconsin division of the Illinois Central, with headquarters at Freeport, Ill., succeeding W. T. GETTY, retired.

M. W. HASSETT, general master mechanic of the New York Central at Buffalo, N. Y., has been appointed assistant superintendent of motive power, with headquarters in New York.

W. H. FLYNN, superintendent of motive power of the New York Central, with headquarters in New York, has been appointed general superintendent of motive power, with the same headquarters.

E. W. SMITH, general superintendent of the Western Pennsylvania division of the Pennsylvania at Pittsburgh, Pa., has been appointed general manager of the Eastern Region. Mr. Smith was born in Clarksburg, W. Va., on September 21, 1885. He was graduated from the Virginia Polytechnic Institute in 1905, and entered railroad service with the Pennsylvania on June 1, 1905. After being advanced through several grades in the motive power department, he served as assistant master mechanic, with headquarters at Wilmington, Del., from October, 1913, to April, 1915. On April 19, 1915, he was transferred to the Altoona, Pa., shops where he served as assistant master mechanic until July, 1916, when he became assistant engineer of motive power. On October 10, 1917, he was transferred to Harrisburg, Pa., as master mechanic in which capacity he served until May 26, 1918, when he was transferred to Williamsport, Pa., where he served as superintendent of motive power. On December 1, 1919, he was transferred to Altoona, Pa., as superintendent of motive power, and on March 1, 1920, he was promoted to engineer of transportation on the staff of the vice-president in charge of operation, with headquarters in Philadelphia. He was appointed general superintendent of motive power, with headquarters at St. Louis, Mo., October 15, 1922, and in June, 1924, was promoted to general superintendent of the Western Pennsylvania division.

E. W. Smith

HAL G. FOSTER, traveling storekeeper of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been transferred to the staff of the vice-president, with the same headquarters, and will be succeeded by C. J. MACKIE.

O. A. GARBER, mechanical superintendent of the Missouri Pacific at St. Louis, Mo., has been promoted to assistant chief mechanical officer of the Missouri Pacific, with headquarters at St. Louis, Mo. Mr. Garber was born on October 15, 1874, and entered railway service in 1891 as a machinist apprentice on the Wabash at Springfield, Ill. After 10 years' service in this capacity he was promoted to erecting and roundhouse foreman on the Baltimore & Ohio at Lorain, Ohio. From 1903 to 1909, he served in a similar position on the Illinois Central at Paducah, Ky., and in 1909 he was promoted to general foreman at Mounds, Ky., later being transferred to Paducah, where he remained until 1912, when he was promoted to master mechanic at East St. Louis, Ill. In 1918 he was transferred to Waterloo, Iowa, and later to Memphis, Tenn., where he remained until March, 1925. He was then appointed mechanical superintendent of the Missouri Pacific, with headquarters at St. Louis.

A. P. HOUSHOLDER, master mechanic of the Missouri Pacific at St. Louis, Mo., has been promoted to mechanical superintendent of the Texas lines of the Missouri Pacific, with headquarters at Houston, Tex. Mr. Housholder was born on November 7, 1879, and began railroad work in 1894 as a machinist apprentice on the Southern at Knoxville, Tenn. In 1898 he was promoted to machinist at Salisbury, N. C., serving there and at Knoxville, Tenn., until 1899, when he became machinist on the Illinois Central at Paducah, Ky. He remained here until 1904, when he became a machinist on the Missouri Pacific at St. Louis, Mo. In 1906, he was promoted to roundhouse foreman at Jefferson City, Mo., later being transferred to St. Louis, where he remained until 1909, when he was appointed general foreman of the Illinois Central, with headquarters at East St. Louis, Ill. In 1912 he was appointed division foreman on the Missouri Pacific at Dupo, Ill., and seven years later he was promoted to acting master mechanic, with headquarters at Nevada, Mo. He was promoted to master mechanic at Nevada in 1919, later being transferred to DeSotto, Mo., and then to St. Louis.

E. F. STROEH, superintendent of shops of the Missouri Pacific at North Little Rock, Ark., has been promoted to mechanical superintendent of the Missouri Pacific, with headquarters at St. Louis, Mo. Mr. Stroeh was born on November 24, 1876. He entered railway service in 1891, as a machinist apprentice with the Cleveland, Cincinnati, Chicago & St. Louis at Bellefontaine, Ohio, and was promoted to machinist before entering the service of the St. Louis, Iron Mountain & Southern in 1897 as a machinist and work equipment inspector. In 1901, he was promoted to roundhouse foreman at Alexandria, La., where he remained until 1903, when he entered the service of the Louisville & Nashville at Paris, Tenn., as a machinist, later serving in the same capacity on the Illinois Central at McComb, Miss. In 1903 he became machinist and air brake inspector on the Louisville & Nashville at Decatur, Ala., and in the same year was appointed machinist and division foreman on the Illinois Central at Paducah, Ky. Later he served until 1910 successively as roundhouse and machine foreman at Fulton, Ky., and as general foreman at Memphis, Tenn. From 1910 to 1912, he was foreman and superintendent of shops on the Missouri Pacific at Hoisington, Kan. when he was promoted to master mechanic at Kansas City, Mo., where he served until 1917. In that year he was promoted to superintendent of the North Little Rock, Ark., shops.

Master Mechanics and Road Foremen

F. R. BUTTS has been appointed assistant master mechanic of the Brookfield division of the Chicago, Burlington & Quincy, with headquarters at Brookfield.

H. W. REINHARDT, master mechanic of the Missouri Pacific at Monroe, La., has been transferred as master mechanic to North Little Rock, Ark., succeeding J. M. Whalen.

J. M. WHALEN, master mechanic of the Missouri Pacific at North Little Rock, Ark., has been transferred as master mechanic to Houston, Tex., succeeding A. P. Housholder.

J. P. ROQUEMORE, mechanical superintendent of the Missouri Pacific at Houston, Tex., has been promoted to master mechanic, with headquarters at Monroe, La., succeeding H. W. Reinhardt.

W. C. SMITH, assistant to the chief mechanical officer of the Missouri Pacific at St. Louis, Mo., has been promoted to master mechanic, with headquarters at Hoisington, Kan., succeeding W. H. McAmis.

J. C. STUMP, general foreman at Butler, Wis., has been promoted to master mechanic of the Peninsula division of the Chicago & North Western, with headquarters at Escanaba, Mich., succeeding C. S. JONES.

ROSTON TUCK has been appointed acting master mechanic of the Arizona division of the Atchison, Topeka & Santa Fe, with

headquarters at Needles, Cal., succeeding G. Searle, who has been granted leave of absence.

C. S. Jones, master mechanic of the Peninsula division of the Chicago & North Western at Escanaba, Mich., has been transferred to the Galena division, with headquarters at Chicago, succeeding Hugh Morris, deceased.

W. A. Langlands, general foreman of the Galena division of the Chicago & North Western at Chicago, has been promoted to master mechanic of the Chicago terminal, with the same headquarters, to succeed W. R. Smith, deceased.

H. H. Urbach, master mechanic of the McCook division of the Missouri Pacific, with headquarters at McCook, Nebr., has been promoted to assistant superintendent of motive power of the lines east of the Missouri river, with headquarters at Chicago.

O. E. Ward, master mechanic of the Chicago, Burlington & Quincy, with headquarters at Alliance, Nebr., has been promoted to superintendent of motive power, Lines west, with headquarters at Omaha, to succeed T. Roope, who has been granted a furlough.

T. E. Paradise, master mechanic of the Hannibal division of the Chicago, Burlington & Quincy, with headquarters at Hannibal, Mo., has been given jurisdiction also over the Brookfield division which has been consolidated with the Hannibal division.

Car Department

D. D. McClure has been appointed master car repairer of the San Joaquin division of the Southern Pacific, with headquarters at Bakersfield, Cal., succeeding Frank Roehr.

Frank Roehr, master car repairer of the San Joaquin division of the Southern Pacific, at Bakersfield, Cal., has been transferred to the Los Angeles division, with headquarters at Los Angeles, Cal.

Shop and Enginehouse

William Henry McAmis, master mechanic of the Missouri Pacific at Hoisington, Kan., has been promoted to superintendent of shops, with headquarters at North Little Rock, Ark., succeeding E. F. Stroeh. Mr. McAmis was born on February 7, 1879, at Rising Fawn, Ga. He received a high school education and on April 1, 1894, entered railroad service as a machinist on the Alabama Midland, now a part of the Atlantic Coast Line at Montgomery, Ala. From 1903 to 1907 he served successively as machinist, foreman and general foreman of the Louisville & Nashville. Subsequently he was machinist supervisor, general foreman and master mechanic of the Central of Georgia at Columbus and Macon, Ga., until 1919 when he became lubricating expert of the Texas Oil Company. From 1921 to 1924 he was general foreman of the Gulf, Mobile & Northern, and during the latter year became master mechanic of the Missouri Pacific at Hoisington.

Purchases and Stores

G. A. Goerner, storekeeper of the Chicago, Burlington & Quincy at Denver, Colo., has been transferred to Aurora, Ill., succeeding C. J. Mackie.

C. C. Kyle, general storekeeper of the Northern Pacific at St. Paul has been promoted to purchasing agent, with the same headquarters, succeeding R. J. Elliott.

C. J. Mackie, storekeeper of the Chicago, Burlington & Quincy at Aurora, Ill., has been appointed traveling storekeeper, with headquarters at Chicago, succeeding Hal G. Foster.

C. E. Swanson, acting storekeeper of the Chicago, Burlington & Quincy at Casper, Wyo., has been appointed storekeeper, with headquarters at Denver, Colo., succeeding G. A. Goerner.

R. J. Elliott, purchasing agent of the Northern Pacific, with headquarters at St. Paul, Minn., has been promoted to director of purchases, with the same headquarters, and will be succeeded by C. C. Kyle.

Obituary

Robert F. Moffett, general car inspector of the Gulf Coast Lines, died at his home in Houston, Tex., on September 16.

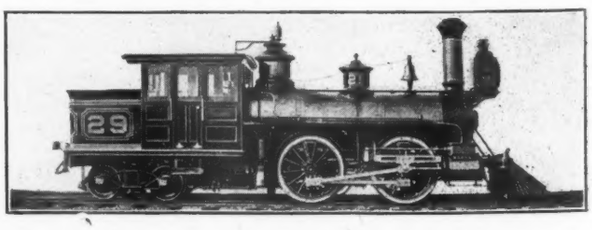
William O. Cook, who retired as a master mechanic on the Denver & Rio Grande Western, in 1925, died on September 18, at Denver, Colo.

H. Morris, master mechanic on the Galena division of the Chicago & North Western, with headquarters at Chicago, died on September 10, at Chicago, following an operation.

W. R. Smith, master mechanic at the Chicago Terminal of the Chicago & North Western, with headquarters at Chicago, died on September 11, at Chicago, following a short illness.

William Henry Fetner, chief mechanical officer of the Missouri Pacific, died at his home in St. Louis, Mo., on September 7, following an illness of several months. Mr. Fetner was born on September 1, 1867, at Columbia, S. C., and was educated in the public schools there. He began his railroad career with the Illinois Central in May, 1881, at Water Valley, Miss., and was consecutively, until 1892, machinist, gang foreman and locomotive engineer with the Southern at Columbia, S. C. In 1892, he became a gang foreman in the shops of the Central of Georgia at Macon, Ga., and he served successively at the same place as erecting shop foreman, general foreman and master mechanic. Later he was promoted to master mechanic for the entire system and on November 16, 1917, he was promoted to superintendent of motive power, with headquarters at Savannah, Ga. He held that position until July 16, 1923, when he was appointed assistant to the president of the Missouri Pacific. On April 1, 1924, he was appointed chief mechanical officer, with headquarters at St. Louis, Mo.

William A. Nettleton, formerly superintendent of motive power of the Chicago, Rock Island & Pacific, died during a trip abroad in London, Eng., on August 30. Mr. Nettleton was born in October, 1863, at Hannibal, Mo. He attended Phillips Andover Academy and was graduated from Yale University in 1885, entering railway service in the same year and serving as rodman and levelman on the Kansas City, Ft. Scott & Memphis (now a part of the St. Louis-San Francisco). In 1886, he entered a student course with the Westinghouse Air Brake Company, and in the next year was appointed inspector of air brakes of the Kansas City, Ft. Scott & Memphis. After a further student course with the Union Bridge Company at New York, Mr. Nettleton was inspector for the Morison & Corthell Union Bridge Company, at Athens, Pa., and for C. A. Boller on the Thames river bridge at New London, Conn. From October, 1889, to May, 1892, he was engineer of tests of the Kansas City, Ft. Scott & Memphis and until August, 1893, superintendent of terminals of the Kansas City & Memphis Railway & Bridge Company, at Memphis, Tenn. For the next two years he served as assistant superintendent of motive power, and in 1895, was promoted to superintendent of motive power and machinery. In January, 1902, he entered the service of the Atchison, Topeka & Santa Fe, serving as assistant superintendent of motive power and consulting engineer until May, 1904, when he was made general superintendent of motive power of the St. Louis-San Francisco and the Chicago & Eastern Illinois. Mr. Nettleton was appointed general superintendent of motive power of the Chicago, Rock Island & Pacific, in March, 1908, which position he held until his retirement in 1911. He was a son of the late George H. Nettleton, who built the Kansas City, Ft. Scott & Memphis.



Tank locomotive built by Brooks in the early seventies